Charcoal Kilns

HISTORIC STRUCTURES REPORT

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WILDROSE CANYON
DEATH VALLEY NATIONAL MONUMENT
CALIFORNIA

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Office of History and Historic Architecture
National Park Service
United States Department of the Interior
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CLASS BB

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APPROVAL SHEET

Recommended

Merrill J. Mattes — Date October 6, 1970
Chief, Office of History and Historic Architecture, WSC

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Acting Director, Western Service Center

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Superintendent, Death Valley National Monument

Concurred in

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Approved

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PREFACE

Death Valley National Monument: Historical Background Study by National Park Service Historian, Benjamin Levy, was published for in-Service use April 15, 1969. A concluding chapter in this report entitled "A Research Program for Death Valley," places the Wildrose charcoal kilns in No. 1 priority. Levy describes these as "the most impressive historic structures in the entire monument." His recommendations follow:

> The Charcoal Kilns ought to be regarded as prime historic structures, perhaps the most significant structures in the Monument. They probably do not relate to a major historic theme in the way that the Harmony and Eagle sites relate to the story of borax. Even so, they are architecturally impressive and appear to be entirely unimpaired -- an astonishing record of perserverance for nearly a century. The number of kilns -- ten in all -- is itself an attractive feature, especially since they are laid out in a perfect line up in the canyon. Several inquiries indicated that a similar complex of like structures could not be found elsewhere. In view of all this, it may be that these kilns warrant designation as historic landmarks; if not, perhaps they qualify as engineering or industrial landmarks.

A trip to Death Valley to make a field study of the charcoal kilns, and for related purposes, was made February 24 - March 1, 1970, by Architect Robert V. Simmonds and Chief, History and Historic Architecture, Merrill J. Mattes, both of WSC.

A search of the Death Valley National Monument library laid the ground-work for the study. Superintendent Robert Murphy and Park

Naturalist Peter Sanchez displayed keen interest in the project and were highly cooperative during field studies. Later they supplied us with helpful data. Park Ranger Dick Powell, stationed at Wildrose, supplied local information of value. Primary research on the Wildrose kilns and related mining activities was undertaken at the Library of California Division of Mines and Geology in the Ferry Building, at the foot of Market Street, San Francisco, and Chief Librarian LeVern W. "Bill" Cutler, Mrs. Margaret Beck and Miss Mary Hill went out of their way to supply leads and facilitate reproduction. Miss Elisabeth Egenhoff, retired editor of Mineral Information Service, (published by the California Division of Mines) cheerfully revealed many key sources. Other sources of some value were the Bancroft Library, Mr. Remi Nadeau of North American Rockwell, Miss Jane Noland of the San Luis Mining Company, San Francisco, and Mr. W. N. Davis, Jr., Chief of Archives, Sacramento.

There was a limited search of Courthouse records at Independence, Inyo County, and the files of the Inyo Independent. However, the key material from this newspaper was available in the San Francisco Mining and Scientific Press, while legal records were available through the California State Archives at Sacramento.

The time available to the Historian on this project prevented exhaustive study, but we believe the essential data is here. The history of the related Modoc Mines, Lookout, Darwin and the broad regional history of Inyo County, involving Indians, gunfights and the violence dear to the hearts of popularizers, is marginal. The hard facts relating to the charcoal kilns themselves are scarce, and the law of diminishing returns set in rather early.

I BASIC FINDINGS AND RECOMMENDATIONS

The charcoal kiln complex is among the more remarkable historical-architectural features of Death Valley National Monument. This is a row of ten bee-hive shaped masonry structures, about 25 feet high, located on a spur road in Wildrose Canyon, Panamint Mountains, near the west boundary of the Monument. These kilns are deemed to be a historical resource of major importance because of these findings:

(1) They have a high degree of structural integrity despite the lapse of nearly a century since their construction.

(2) They are associated with the Modoc Mine in the Argus Range (30 miles to the west, outside of the Monument) which achieved some fame as a silver producer in the 1870s and 1880s.

(3) They offer a unique opportunity to interpret a lost industrial art -- the operation of charcoal kilns to provide fuel from local timber for the local smelting of precious metals in remote wilderness areas of the west.

(4) They are believed to be the best known surviving example of such kilns to be found in the western states.

(5) They are accessible by auto road, affording Monument visitors an opportunity to witness this evidence of frontier mining activity amid the wild charm of the Panamint Range contrasting with desolate Death Valley.

A suitable program of preservation and interpretation will be based on the following recommendations:

(1) All ten charcoal kilns should be restored as nearly as possible to original condition and appearance, with exception of costly and easily vandalized metalwork doors.

(2) The following general guidelines will apply to such restoration: All stone work shall be checked for soundness and as found loose, reset. Missing stones shall be replaced with site available stone. Mortar shall be similar in texture and color to original mortar. The exterior shall be covered with a thin mortar with voids between stones packed solidly. No interior work is anticipated unless found in an unsound condition. The estimated construction cost is $24,000, including $6,000 for plans, supervision and contingencies.

(3) A limited archeological study, as indicated below, will be fruitful for interpretive purposes.

(4) Landscaping treatment will be defensive only, that is, to keep the immediate area of visitor interest clear of hazards. The wild natural setting should be preserved.

(5) Method of interpretation remains open, although "living history" here, in terms of actually making charcoal, appears highly impractical. However, historical data available suggests that other exciting new dimensions are possible.

(6) Administrative requirements will be minimal. Although stationing of a seasonal interpreter here is not out of the question, it appears that, because of remoteness, this historic feature will have to be primarily self-guiding. The only protection suggested is frequent ranger patrols out of the Wildrose Ranger Station, as at present. Any exhibits, if not vandal-proof, should be replaceable at modest cost.

II DATA SUMMARY

A. HISTORICAL DATA

The Wildrose charcoal kilns were completed in 1877 by the Modock Consolidated Mining Company to provide a source of fuel suitable for use in two smelters adjacent to their group of lead-silver mines in the Argus Range west of Panamint Valley, about 25 miles distant from the kilns. Although the mines themselves were worked intermittently until about 1900, there is no clear evidence that the charcoal kilns were operational after 1879. Evidently either other fuel sources were located or it was found to be more profitable to ship the raw ore elsewhere for processing. This short life may help to explain the remarkably good condition of these kilns, nearly 100 years after their construction.

One of the incorporators of the Modock Company, operating out of San Francisco, was George Hearst, father of William Randolph Hearst. George Hearst became famous as a mine expert, and his immense wealth was derived from interest in various mines. However, the Modock group (locally spelled Modoc) was not one of his great successes. Apparently it did not gross much more than $3,000,000 over a period of thirty years. Beginning about 1881 the mines were leased to others. They have been inactive since the turn of the century.

Associated with the Modock mines were the neighboring towns of Darwin and Lookout, rough towns which out-lived the more famous Panamint. A trail from Lookout to Wildrose Canyon was constructed. Charcoal was transported to the smelters by jackass pack-trains, though wagons also were probably involved.

A company man named Morris built the Wildrose kilns. Actual documentable details of the construction job and the operation are lacking, as is confirmation that the labor forc- included Indians and Chinese. The presence of Mexicans is amply indicated. It seems logical that, with a fairly large labor force of wood-cutters, charcoal-burners and haulers, there would be a "settlement" of some kind, with tents and/or log cabins, and there is one hint of a town of "Wild Rose." It was probably an ephemeral affair. Its exact location is unknown, but a fair guess would be that it was a summer camp near the kilns, where water would have to be hauled in; or else it was located in the vicinity of the life-giving Wildrose Spring, several miles downhill from the kilns.

(For more details, see History section.)

B. ARCHITECTURAL DATA

Near the head of Wildrose Canyon a row of ten conical shaped ("beehive") charcoal kilns were constructed of site-quarried chlorite stone at an elevation of 6880 feet above sea level amidst a pinyon pine forest in the 1870s (see history section). Each kiln varies in size from 30' - 4" in diameter to 32' - 11" with an average height of 25' - 6".

Each kiln rests on a circular stone foundation 3' - 0" in thickness and of unknown depth, 5' - 0" assumed. The actual conical shaped wall of the kilns start their parabolic curve at the top of the foundation. The wall thickness starts at 24" to 26" in depth and narrows toward the top to about 12", thus creating two distinct parabolic curves, one curve outside, one curve inside. Contrary to what one might expect, and also in contrast to other known varieties of charcoal kilns, these particular kilns had no apertures for venting at their apex.

The kilns are entered at the southwest through a stone arched doorway. The stone openings taper inward and their size varies; kilns #4 through #10 measure outside 4' - 8" wide x 6' - 0" high; inside 4' - 0" wide x 5' - 8" high. Kiln #3 measures outside 4' - 4" x 6' - 0"; kiln #2 outside 4' - 0" x 5' - 8"; kiln #1 outside 4' - 0" x 5' - 4". Metal doors (now missing) closed the openings.

Evidence available today does not positively show how the doors were secured. Scorch marks on the stone suggest that an iron door frame was not used and that the door itself was simply placed on the foundation, which acted as a threshold, and then rested against the tapered opening. It can be assumed that the curve of the wall held the door by gravity and that the taper of opening kept the door from falling into the kiln. Construction of the door was heavy flat sheet iron reinforced with iron bars riveted to the sheet. Two U-shaped handles of round iron rod were flattened on the ends and riveted to the door. (Specimen at Monument headquarters).

A rear door directly opposite the front entrance is located in the wall, measuring 12' - 0" at the sill above the foundation. The door opening is constructed in the same manner as the front entrance with the exception of kilns #3 and #4 which have arched brick lintels. The opening size outside is 3' - 0" wide x 3' - 8" high with a wall thickness of 20". The opening was closed with a similar metal door as the entrance with exception of a 5" diameter hole at the top which served as a vent. The purpose of this opening, apparently, was to facilitate the upper stacking of wood. Presumably also it provided some measure of draft control.

The kilns were constructed on a hillside which was quarried out for material and to provide a level site for the kilns. The stone used was chlorite roughly shaped to a 6" x 12" x 8" average size.

The mortar was a lime, sand and gravel mix. This stone masonry mortar was originally used also for the interior and exterior plaster finish. The interior plaster is remarkably solid and blackened by smoke. However, the exterior shows very little remnants of plaster as noted on the photo elevations.

Historic photos, circa 1930s, indicate that several of the entrances were rebuilt or stabilized by the CCCs.

Air was introduced into the kiln by three (3) rows of vent holes through the walls approximately 4" x 4" in size. Each row of vents is spaced 1' - 6" apart vertically with the bottom row starting at the foundation. Horizontal spacing between vents varied because of stone size but generally are 18" to 24" on center.

The floor of the kilns are level and consist of solidly compacted charcoal, ashes and gravel.

See photograph section and architectural drawing, including location map.

C. ARCHEOLOGICAL DATA

No archeological investigation of the charcoal kilns per se have been made. None will be needed prior to rehabilitation. However, archeological testing of the kiln floors and immediate vicinity of the walls might yield artifacts of interest. Surveys of the area might relocate auxiliary structures (i.e., shelter cabins) believed to have existed in the vicinity at one time.

There has been archeological study of Wildrose Canyon generally, including Indian ruins which are in the vicinity of the kilns (see section on Wildrose Canyon). These ruins should be protected during any work on the kilns.

D. LANDSCAPE DATA

The kiln site is located adjacent to a gravel road on the northeast slope of Wildrose Canyon in a cutover pinyon pine woodland. The soil consists of rock and gravel with slight vegetation cover. Encroaching brush should be removed. There is ample room for interpretive exhibits and informal parking.

E. FURNISHINGS AND EXHIBITION DATA

It is proposed not to replace the metal doors, and the structures will be left open to the public. Interpretation will be by metal photo signing or other similar display media at the site as may be determined by interpretive planners. Exhibits should not be placed on or within the kilns.

III DATA ON WILDROSE CANYON

DISCOVERY AND NOMENCLATURE

According to California Place Names Wildrose Spring and Canyon were discovered and named in 1860 by Dr S. G. George and party out of Visalia, searching for the lost Gunsight Lode.[1] Nearby Telescope Peak was named at this time also. In 1861 Dr. George returned to work his mining claim in Wildrose Canyon, leaving four men to work it who were killed by Indians, according to one guidebook.[2] According to another version, Dr. George's discovery occurred in 1861 and in the following spring (1862) he returned with a strong force of prospectors "well armed and equipped for a voyage of discovery." They located many mines and named the Inyo Range because the word "Inyo" seemed to be the only one in the Indian vocabulary.[3]

The Lookout Mining District, and the Modoc Mine west of the Panamint Valley, which figure prominently in the story of the Wildrose Kilns, reflect names typically selected by miners on the basis of romantic fancy. However, the town of Darwin which also figures in this story derives its name from Darwin Wash or Canyon, discovered

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[1]Erwin G. Gudde, California Place Names (Berkeley, 1960), 347, citing Henry G. Hawks, Third Annual Report of State Mineralogist (San Francisco, 1883), 34.

[2]Federal Writers' Project, WPA, Death Valley, A Guide (Boston, 1939), 20.

[3]Production of Precious Metals in the U.S. (1883), 153.

and named in 1860 by Dr. Darwin French of Fort Tejon, also in search of the mythical Gunsight Lode. French is also credited with naming of Panamint Valley and Range, and Furnace Creek in Death Valley (where he found furnaces "that were used by the Mormons for smelting the galena and carbonate ores with which this section abounds").[4]

TOPOGRAPHY

Wildrose Canyon runs in a roughly east-west direction about 13 miles long. Structurally, it widens from its mouth where it measures less than $\frac{1}{4}$ of a mile inland to a maximum of $1\frac{1}{2}$ miles and then narrows again in its upper reaches. There is a general upslope of the valley floor from about 4000 to over 8000 feet in elevation.

The valley is flanked on either side with rugged mountains which rise steeply above its floor. Their sides are furrowed with many gulches and narrow canyons and the lower slopes are piled high with rock debris. The uneven valley floor is covered with boulders, gravel, sand, and silt washed down from the surrounding heights. Branch canyons extend back into the mountains at many points, dwindling to narrow gorges in their upper reaches.

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[4]Gudde, op. cit., 80; Federal Writers' Project, op. cit., 19; Production of Precious Metals (1883), 153.

CLIMATE

This is a semiarid region, as the high Sierra Nevada peaks to the west shut off moisture-bearing winds from the Pacific. The average yearly precipitation probably does not exceed 10 inches. Much of this falls during summer thunderstorms with occasional heavy downpours in the surrounding mountains. These result in a heavy run-off and are extremely destructive as detritus is carried down from the bare mountain slopes in enormous quantities. The rainstorms are supplemented in the upper Wildrose Canyon by winter snowfall, which occasionally reaches down to the mouth. An effect of little precipitation is the scarcity of surface water. The drainage systems are dry except after heavy storms when they are transformed into watercourses or even torrents which run for only a few hours. Springs producing a continuous flow of water from the ground are correspondingly small and few in number with only 6 in the district. Wildrose Spring at the mouth is a famous locale.

The season of greatest warmth is from May to October. Summers are surprisingly hot for the elevation, with temperatures of more than 100° F. recorded. The altitude is great enough, however, to give cool nights. The temperature is subjected to great variations not only between day and night but also between summer and winter. Winters are bitterly cold. Winds throughout the year are variable, often strong and steady, becoming gusty at times.

VEGETATION

The lower valley lacks trees but is dotted with low shrubs among which black brush and Mormon tea are most noticeable. Along with these on the rocky south slopes are creosote bushes. The upper valley from about the 6,000' level has a woodland of scattered Utah Juniper and single-leaf pinyon pine, which is among the more drought-resistant of western cone-bearing trees. They are supplemented at higher elevations by mountain mahogany and sagebrush. In the moister soils adjacent to stream courses and particularly around springs, are willows.

WILDLIFE

Wildlife is not particularly abundant. The native mammals are primarily small forms, especially rodents and rabbits. Of the former there are the desert antelope ground squirrel, Panamint chipmunk, white-footed mouse, jumping mouse, and desert wood rat. The black-tailed jack rabbit and the cottontail are both present. Carnivores are represented by the desert coyote and an occasional desert bobcat. Nelson bighorn make their home in this region along with a few mule deer. Several species of bats round out the list of mammals. Reptiles, mainly lizards, are the most conspicuous element of the animal life. One of these is the large herbivorous chuckwalla.

ARCHEOLOGY

Wildrose Canyon was visited seasonally by Death Valley Shoshone. The main subsistence area for the Furnace Creek people was in the Panamint Mountains and several of their summer camps were in Wildrose. The canyon was easily entered from Death Valley Canyon, on the east slope of the Panamints, which leads directly from the floor of Death Valley to upper Wildrose. Another possible though more circuitous route was through Emigrant Pass, the main passage westward through the Panamints. One summer campsite was at a spring called Ko'near, at the head of Death Valley Canyon. From here it was but a short journey to Mahogany Flat at the end of Wildrose Canyon. Thorndike Spring at the head of Wildrose was sometimes a camping spot. Another camp was at Wildrose Spring in the lower valley. The same territory was visited year after year. Indians from Panamint Valley to the west may also have entered Wildrose.

The nuts of the pinyon upon which they seasonally placed their chief dependence for food, attracted the Death Valley Shoshone to Wildrose Canyon. By early fall the nuts began to ripen and the people moved in to harvest them. The yield varied considerably from year to year with abundant crops coming every few years. When particularly good, a large surplus could be accumulated of a food that with its thick shell would keep for a year or two. Part of the harvest was cached in the mountains. It is not known whether pine-nut expeditions ever wintered in the mountains when crops were especially good. Occupation during this season would have been uncomfortable at best. Although the pinyon nut was the primary attraction, the seeds and edible portions of other plants also furnished food. The bighorn was certainly an attraction, as well as smaller game mammals and birds.

This country was until quite late in the 19th century virtually untouched by western civilization. It was then entered by miners, wood-cutters, and charcoal-burners. Little of the aboriginal material culture survived beyond the period of initial contact as the Indians became more and more dependent upon their white neighbors for implements and tools and even for their livelihood. The Death Valley Indians continued to visit the region annually until 1940.

The archaeological reconnaissance of Wildrose Canyon was carried on by the Department of Anthropology, University of Southern California, August 7 to August 29, 1953.

The Wildrose Canyon district was selected for archaeological study for 2 reasons. Its accessibility and size made it suitable for a short reconnaissance. Because it was known to have been visited seasonally by the historic Indians, it was hoped that some idea of a seasonal phase of their life could be obtained. The region had not been examined previously though a few petroglyph sites had been noted.

There was a paucity of archaeological remains in Wildrose Canyon. This can be attributed in part to the devastating effects of erosion. Many traces of habitation have been carried away by flash floods or covered deeply by rock debris. The activity of miners and woodcutters have destroyed some evidences as has recent roadbuilding and other construction work, particularly in the lower valley.

The general scarcity of prehistoric remains can be explained in large part, however, by the absence of permanent aboriginal settlement. The district was inhabited seasonally by relatively few individuals. Peoples moving frequently and carrying on their backs not only their belongings but also foods procured in different places limited their baggage and carried with them only necessary objects such as baskets used in seed harvesting and weapons. Even the former were often cached to be picked up and used the following season. Local materials were employed for makeshift tools and discarded when no longer needed. While in temporary camps, simple windscreens of brush, which leave few traces, sufficed for shelter.

Forty-five archaeological sites were recorded. These can be classified into 7 categories:

1. Campsites. Most numerous were camping places, 30 of which were located.

2. Workshops. Three sites, all in lower Wildrose Canyon, produced no evidence of human presence other than chips of jasper, chert, and obsidian, and were classed as workshops.

3. Rock Shelters. Ten rock shelters suitable for human occupation were examined but only 2 contained evidences of utilization by Indians.

4. Milling Places. Three sets of bedrock mortars were noted.

5. Storage Pits. Circular pits, built by making a shallow excavation and throwing out a quantity of loose stones to form a crater-like depression, were observed at several localities.

6. "Hunting Blinds." Stone walls apparently for the concealment of hunters were noted around a spring.

7. Petroglyphs and Pictographs. Both petroglyphs and pictographs were found, 5 occurrences of pecked figures and 1 of painted. The rock pictures were scattered at random through the higher mountains and isolated side canyons, in spots quite remote from campsites and springs.

The remains of dwellings were encountered at 17 sites, mostly consisting of "house circles," small cleared spaces of earth banked around with roughly piled boulders. The clearings were made either by picking out each individual stone or by raking the larger stones outward to form the enclosing rim, thus leaving a sandy or gravelly surface. The floors were flat, or in a few cases slightly depressed. The circles normally had an entryway on one side; these were not consistently oriented. In diameter the circles ranged from 6 to 15 feet, averaging between 8 and 9 feet. One had a subsidiary circle about 2 feet across adjoining the main one. These "house circles" probably represent remains of temporary structures designed only for the few days or weeks the people would spend at a food-collecting camp. Originally they probably enclosed walls of poles and brush forming temporary windbreaks of the type constructed by modern Shoshonean groups.

The remains of a large unroofed shelter were still standing near the spring in back of the charcoal kilns (WR1). This was about 21 feet in diameter with walls 6 feet high. Pinyon boughs were bound to 4 living trees to form a framework which was covered with various materials -- burlap, corrugated iron, and brush. A roughly circular stone hearth was in the center of the structure. The dwelling was occupied seasonally until the late 1930s by Johnny Shoshone, a well-known Death Valley Indian, and his relatives. This is a larger and more complex structure than those constructed in the precontact period. A litter of tin cans, broken glass, and other rubbish surrounded the shelter. The only aboriginal objects recovered from the debris were a fragmentary arrowshaft straightener, 2 obsidian flakes exhibiting "use-chipping," and 2 milling slabs found nearby.

Clustered around the spring above the charcoal kilns are 3 stone walls (WR24), 2 circular, about 9 feet across with walls 2 to 3 feet high, the third roughly rectangular, 10 feet long with one wall 4 feet high. It is probable that these were booths or blinds for game shooting. A hunter concealed behind one of the walls would have had an unobstructed view of any game animal approaching the spring. The Death Valley Shoshone employed comparable stone blinds for hunting bighorn. Two nearby circular excavations, 6 feet across and 3 deep, also could have hidden waiting huntsmen.[5]

WILDROSE MINING DISTRICT

Since the charcoal kilns in question are associated with the Modoc Mine some 25 miles to the west, across the Panamint Valley,

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[5]William James Wallace and Edith S. Taylor, "Archaeology of Wildrose Canyon, Death Valley National Monument," American Antiquity, XX, No. 4 (1955), 355-360.

it is all too easy to overlook the fact that Wildrose Canyon itself and immediate environs was subjected to intensive prospecting and several small mines were developed there before, during and after the period 1876-79 hypothesized for the kilns. (There is no evidence that these kilns were used by any mine-owners other than the Modoc owners.) The extent of the Wildrose mines is indicated in the accompanying contemporary map of the Inyo County mines, as well as in the following official report of 1883:

> Wild Rose district lies on the northern portion of the Panamint Range of mountains, with a formation of lime, slate, and granite metamorphosed.
>
> In Wild Rose Cañon are found several veins of antimonial ore, ranging from 30 to 60 feet in width; also several prominent ledges of silver-bearing veins.
>
> The Virgin, Peru, Kuler, Silver Star, &c., all carry high-grade ores.
>
> In the northern portion of the district is the Mohawk, developed by both tunnel and shaft, with a vein of silver-bearing ore of from 3 to 4 feet thick.
>
> The Blue Bell is developed by an incline of 100 feet and several shafts. One hundred and fifty tons of ore on the dump gave an average assay of $100 per ton. The ores are being shipped to San Francisco. The mine is being developed only from proceeds of the ore.
>
> The Valley View and the Umpire in this vicinity show high-grade ore with veins from 3 to 4 feet thick.
>
> From this point northerly about 6 miles are found the Argonaut, Genette, and Empire State, all of which are silver-bearing mines. The Genette, the best developed of the group, has a shaft 100 feet deep, with a 4-foot vein

of free-milling chloride of silver ore. The vein is a contact between dolomite and granite, and assays from 50 to 100 ounces per ton of silver.[6]

A 1939 guidebook reports a number of ore deposits in this canyon. "For a number of years the ore was smeltered in small, square, stone furnaces. A few mines are still worked; threadlike roads run up the hills to the buildings, and finer threads run from the buildings to the workings. On the hills (3.4 miles from Wildrose junction) is a scar left by the pipeline that carried water from Telescope Mountain to the now extinct town of Skidoo."[7] Thirty years later these phenomena are still in evidence along the road to the kilns. One researcher who has tramped the back-country reports that

> . . . The artifacts of the mining "civilization" are everywhere present in the area. Kitchen middens of rusting sheet iron and shovels; forgotten axes, the bits dull and the handles weathered; broken glass and bottles burned purple by the sun, all attest to the ubiquitousness of the miners. The current crop of "desert rats" who drive their jeeps and motor scooters up and down the slopes collecting these artifacts, probably are doing as much damage today to the vegetation as the miners' burrow once did.[8]

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6 Production of Precious Metals in United States (1883), 163.

7 Federal Writers' Project, W.P.A., Death Valley, A Guide (Boston, 1939), 50-51.

8 Patricia J. Rand, Asst. Prof. of Botany, Univ. of Nebraska, Lincoln, "Plant Ecology Investigations in the Pinyon-Juniper Woodland, Death Valley National Monument, California," mimeograph (May 1969).

Today dwarf timber grows in profusion along the canyon and particularly in the vicinity of the kilns. This is a bit surprising since one might suppose that all the timber-cutting that went on in historic times would leave these forests denuded. What has occurred of course is abundant re-growth; in any event it is obvious that the wood-cutters did not "clear-cut", they cut older and bigger trees suitable to their purpose. The above-mentioned researcher also observed a number of stumps and suggests that timber losses in the 19th century may have been heavy enough to cause some retrogression of the whole pinyon-juniper stand.[9] Other researchers have made increment borings of 26 pinyon stumps presumed to have been utilized as fuel for the Wildrose charcoal kilns. Their tree-ring studies confirm cutting in the historic period 1876-1879.[10] Dr. Charles Hanson, Research Biologist, informed Park personnel that the center trunks of many trees were cut leaving the lower branches unharmed. Therefore many of these trees are alive today.

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[9] Ibid.

[10] C. W. Ferguson and R. A. Wright, "Tree Ring Dates for Cutting Activity at the Charcoal Kilns, Panamint Mountains, California." Tree-Ring Bulletin, Vol. 24 (January 1962), 3.

IV DETAILED HISTORY OF WILDROSE CHARCOAL KILNS AND THE MODOC MINES

Every writer on Death Valley recognizes the historical value, or at least the curiosity value, of the charcoal kilns in Wildrose Canyon. Accordingly, various statements have been made about the dates of these kilns and the circumstances of their construction and use, although these statements are never documented and often conflicting. As a result we have a body of hearsay tradition in which is buried the kernel of truth, but certainly not the whole truth. Because of the prevalence of untruths and vague half-truths on this subject, it seems appropriate first to quote verbatim from various sources to sum up the hitherto prevailing body of knowledge on the subject. Where asterisks appear in the following, the statements are dubious in the light of current research.

1. <u>NPS sign at site:</u> In 1870* three hundred men* cut juniper and pinyon pine and sledded* it to these kilns. The charcoal was then carted by mule train to the gold* and silver smelters at the Modoc mines in the Argus Range west of Panamint Valley. Indian labor* may have built these 'beehives.'

2. <u>Exploring Death Valley:</u> In the 1860's* the pinyon pines in upper Wildrose Canyon were the nearest source of fuel* for the smelter at the Modoc Mines, owned by George Hearst, father of the late publisher William Randolph Hearst.* Accordingly, the Kilns were built to make charcoal, which was then packed on mules 25 miles across Panamint Valley to the smelter. The Kilns were designed by Swiss engineers,* built by Chinese laborers,* and stoked by Death Valley Indians.*

All ten Kilns still stand. They are 30 feet across and look like enormous beehives made of stone. A small lime kiln is up the hill from them.*[11]

3. National Geographic: Like abandoned tepees, charcoal kilns await fires that will never burn again. To produce fuel for smelters, mine owners hired Shoshone Indians* to stoke these 30-foot high ovens, built in upper Wildrose Canyon in the 1870's by Chinese laborers.*[12]

4. The Charcoal Kilns: In the year of 1860* two silver and gold* mines were started in the Argus Range. These mines are located directly across Panamint Valley from the mouth of Wild Rose Canyon. As there were no smelters within a profitable shipping distance, the owners of the Modoc and Minnietta mines built their own smelters.

   Their next problem was fuel to operate these smelters. During this time there had been a considerable amount of trees washed down from the sides of the mountains along Wild Rose into the canyon itself. This indicated a fuel supply in the tree growth upon the mountains, and the owners of the mines decided to build large charcoal kilns at the upper end of Wild Rose Canyon.

   These kilns were built under the supervision of engineers with Indian labor.* They are constructed out of stone, lime mixed with sand and a few bricks. Due to the hardship of transporting material to the location, they decided to use what materials were already deposited there by nature. One will notice when he visits the kilns that there is a small kiln in back of the large ones. This was used for burning the lime so it would be of use for cement.* There is no record of where the bricks or iron doors came from. These kilns are perfectly built. Today, seventy-five years later, they are still rigid, and the cement and stone are still intact.

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[11] Ruth Kirk, Exploring Death Valley, Stanford University Press, Stanford, California (1959), 55-60.

[12] Rowe Findley, "Death Valley, The Land and the Legend." National Geographic, V. 137, No. 1 (January 1970), 72.

> In using the kilns, wood was gathered and put into them and ignited. The kilns are so built that the wood smolders and bakes instead of burning actively. When it had been converted into charcoal, it was transported to the mines which were twenty-five miles away. The fuel was carried by a train of mules down Wild Rose Canyon, into Panamint Valley, and across to the smelters in the Argus Range. The mines continued in production until about 1900 and produced during that time somewhere around three or four millions of dollars, making the investment involved in the construction of the kilns a worthwhile one indeed.[13]

The search for documentable facts regarding the charcoal kilns, as distinct from undocumented tradition, started at the Death Valley National Monument Library. It climaxed, happily, at the library of the California State Mining Library in the Ferry Building, San Francisco, California. Here was the repository, not only of most Federal and State government mining publications, but a complete run of San Francisco's own Mining and Scientific Press, which began publication in 1866 and continues to this day. This trade journal runs a weekly section on field mining news from all over the Rocky Mountain West and the Pacific Coast, sometimes getting the word directly from their own correspondents, or knowledgeable visitors to San Francisco, but more often quoting verbatim from local newspapers.

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[13] Anonymous, "The Charcoal Kilns," Thorshun (Official publication of the Death Valley CCC Camps), Wildrose Canyon, Trona, California (June 1, 1936).

Primarily through this source, during the period 1876-1883, often quoting the Coso Mining News published at Darwin, the Independent published at the county seat of Independence, and the neighboring Kern County Courier, a valid though incomplete historical picture emerges of the charcoal kiln operation and closely related mining activities across the Panamint Valley in the vicinity of Darwin, particularly as it related to the Lookout Mining District and the Modoc (officially Modock Consolidated Mining Company, but locally spelled Modoc). Although the Argus Range, Darwin, Lookout, the Modoc and related mines are all west of the Panamint Valley and thus well outside the National Monument, the fact is that the charcoal kilns cannot be understood or interpreted except as they are identified with the Modoc operation. Therefore our history will interpret the more complete mining picture of the times, rather than treat the kilns as architectural curiosities only. This history of the Modoc Mines will be limited to essentials for reader convenience.

According to a report by the California State Mineralogist, the constellation of mines owned by the Modock Consolidated Mining Company, or rather, the presence of silver and lead in paying quantities which resulted in these mines, was detected and claims first staked out in 1875.[14] This is supported by Captain Wheeler's

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[14] 12th Annual Report of California State Mineralogist, 1893-1894.

Survey report of 1876 based on Lieutenant Rogers Birnie's examination of the Lookout District in August 1875, which has it that "the District was discovered in May of the present year by Jerome Childs. It was organized in July."[15]

In May 1876 the Kern County Courier speaks glowingly of "that new and much talked of mining district of our back country. . . . In Lookout District, 10 miles east of Darwin, the Modoc Company has found an immense body of first class ore, and will soon have a furnace or mill erected. . . . The Modoc Company recently run into a body of ore claimed to be the richest deposit of silver ore ever discovered on the West Coast." The dispatch mentions also the Defiance, New Coso and Coso Consolidated mines in the immediate vicinity of Darwin. Of the town itself the Courier "says it had a quick growth, but is now comparatively quiet."[16]

There was a Modoc Mine, but the Modock Mining Company had several other neighboring mines as part of the Modoc group, the dominant factor in the Lookout Mining District. Since the two

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[15] George M. Wheeler, Annual Report Upon Geographical Surveys West of the 100th Meridian (1876), 67-68.

[16] Mining and Scientific Press, XXXII, No. 19 (May 6, 1876). Darwin itself apparently came into being in 1875. In that year Wheeler, op. cit., reports only 40 people in the entire district.

smelters which were fired by charcoal from Wildrose Canyon apparently served several mines in addition to the Modoc proper, recognition must be made of other mines in this context. The earliest company mines identified are the Confidence, the Eclipse and the Kentuckian.[17]

Reduction of ore to sort out precious metal was accomplished in this period by either of two basic methods: stamping (or pulverizing) and smelting (or melting by heat). The Minnietta or Minnietta Belle, the most prominent of Modoc's rivals, is described as "a veritable bonanza," requiring a ten-stamp mill to process the ores. The Coso Mining News for September 23 reports that two furnaces are being constructed for the Modoc group. "Teams have been sent to Panamint for more piping, and as soon as they return the pipe connections for the tanks to the water jackets will be made, then the furnaces will be put into operation." Rich ore bodies are reported for the Lookout Mine and Confidence No. 4, resulting in "a splendid pile of ore on the dumps." If the furnaces work, "we may expect to record as large & fine shipments of base bullion as ever went out from Inyo County."[18]

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[17] Ibid.

[18] Ibid. XXXIII, No. 14 (Sept. 30, 1876). The Panamint District and the hell-roaring town of Panamint, referred to, are on the western edge of Death Valley National Monument (see Inyo County map).

In October 1876, J. A. Crossman of the California Bureau of Mines pronounced the Confidence to be the most valuable of the Modoc properties, with "2000 tons of high-grade ore on the dump" running high in lead and silver. Lookout, filled with "high grade argentiferous galenas, promises a brilliant future . . . the Modoc shows a blanket of high grade ore" but its extent is to be proved. "The 60-ton furnaces are ready to start up. The Company has excellent boarding houses, blacksmith shops, etc. which are perfect in all their appointments."[19] Thus we have record of the birth of the mining village of Lookout, on the mountain slope near these mines and not to be confused with the local "metropolis" of Darwin.

Also in October the Modoc operation was visited by George Hearst and other mining experts to witness the start of the company's furnaces, "and all express themselves highly gratified with all they have seen." Superintendent Barber considered that "the furnace is working charmingly," running five bars per hour, and getting a ton of bullion for three tons of ore. The bars average 90 pounds each, and assay between $400 and $500. The Wells Fargo Express Company carried the precious metal to San Francisco without

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[19]Ibid., XXXIII, No. 16 (October 14, 1876), quoting Coso Mining News for Oct. 7.

incident. The editor concludes that "the success of the Modoc is the commencement of a new era for our whole mining section."[20]

A November report is highly optimistic: "Modoc Village [Lookout] is assuming a most lively appearance, and its people feel sanguine of a bright and permanent future . . . . Already $100,000 have been taken out by the furnace process" and "we can fully anticipate a handsome dividend for Modoc stock owners." The report notes the construction of a road connecting the Minnietta and Modoc Mines to the Panamint Valley Road. Likewise, "surveying parties have gone across Panamint Valley to bring in a road from Wild Rose over which will be transported coal and timber supplies."[21]

The above is the first reference to Wildrose coal supplies in contemporary records. While the charcoal kilns that survive today had not yet been actually built it is apparent from the Oliver Roberts' story (see below) that charcoal-burning in pits and other primitive facilities was then being practiced on a large scale at Wildrose to feed the voracious boilers at Modoc and elsewhere throughout the region. In any event, the Modoc was the dominant

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[20] Ibid., XXXIII, No. 17 (October 21, 1876) and No. 18 (October 28, 1876), from Coso Mining News. (See later section for discussion of Hearst involvement.)

[21] Ibid., XXXIII, No. 22 (November 25, 1876) and No. 23 (December), from Coso Mining News.

factor in the territory at this time, according to the Inyo Independent:

> Not less than 500 mules and quite an army of packers, teamsters, coal burners, wood-choppers etc. are constantly employed in furnishing coal and other local supplies. This and the freighting interests combined has built up a little town in Darwin Wash, which is said to be by odds the liveliest in the county. The furnaces are receiving no less than 3,000 bushels of coal per day. The average out-put of one furnace since Oct. 9th, when it was first started up, is close on to 160 bars every 24 hours; a second furnace of the same capacity will soon be in constant operation, and then the daily yield will be over 300 bars, or about 13 tons of bullion, which heretofore has been worth $490 per ton; in round numbers $6,500 worth every day.[22]

According to the Coso Mining News, the Modoc Company celebrated Christmas by making their ten thousandth bar of bullion, with value of bullion shipped by December at $88,000. "Both furnaces running well. Water plentiful." A tabulation of California Quartz Mines yield from 1876 lists 22 mines. By far the largest in Inyo County is the Modoc at $260,000. (This is eclipsed by certain high-yield mines in Klamath, Amador and Nevada County, though only one of these exceeds a value of $500,000.) It is noted also that the total California yield of $18,600,000 is "not so large as in the early day of mining."[23]

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[22] Ibid., XXXIII, No. 26 (December 23, 1876).

[23] Ibid., XXXIV, No. 2 (January 13, 1877), from Coso Mining News; XXXIV, No. 3 (January 20).

No other clue has turned up on the "Mr. Morrison" who built -- and probably also designed -- the kilns. One of the folklore items is that the kilns were built by a Swiss engineer.[28] The name does not seem to bear this out. Related folklore is to the effect that the kilns were built by Chinese labor, and stoked by Shoshone Indians.[29] No documentation has turned up to support this fanciful concept. The Oliver Roberts' account considered below does indicate the use of Mexican labor in the earlier pit kilns, and indicates also the presence of Indians in the area. However, Roberts' Indians, involved in a lot of devilment, were certainly no part of the charcoal labor force.

In December 1877 a Mr. Guptill appears as the new Modoc Superintendent, while John S. Gorman became the new furnace operator, a fact viewed as fortunate since "this company has met with so much misfortune lately in their smelting operations." The misfortune, apparently, was in the breakdown of the furnaces from continuous use, a situation not easily remedied because of the absence of repair parts, and the length of time consumed in obtaining such parts by wagon or stage from San Francisco. Because of this problem, coupled with "a vast reduction in the price of lead" the labor force of about 50 men -- miners and furnacemen -- had to be reduced. However,

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[28]Kirk, op. cit.

[29]Ibid.

an effort to reduce wages below the level of $4 per day was defeated by a worker's rebellion. As a result of the trouble at the Modoc, as well as neighboring mines (the New Coso Superintendent was chased out of the territory), the Coso Mining News confesses that this winter "times in Darwin are very dull."[30]

In the spring of 1878 things were looking up for the Modoc. On March 20 the Inyo Independent confided that important developments were pending.[31] The Coso News of May 4 trumpeted the fact that the two furnaces were almost ready for action. The May 11 issue reported that happy days were here again:

> Both furnaces are now running to perfection and turning out 200 bars of bullion every 24 hours, the bars weighing an average of 85 pounds each. Thirty-eight tons of ore are running through each 24 hours. The fact that there were 50,000 bushels of coal on the dump to commence with, a reserve of 16,000 bushels at the kilns in Wild Rose Canyon, and the further fact that Mr. Guptill has put a force of men at work to run the ten kilns, of 42 cords capacity each, and to burn also in pits, and is also purchasing coal from this side of the mountains as well, is pretty good evidence that the Modoc furnaces will run for a long time. Shipment of rich bullion was commenced on the 8th inst. Ten tons being sent to San Francisco and 20 tons more followed on the 10th. Mr. Guptill expects to ship 10 tons daily, and undoubtedly that amount will be increased. The mines are looking well and yielding the usual amount of ore, more than sufficient to keep the furnaces supplied.[32]

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[30]Ibid., XXXV, No. 24 (Dec. 15, 1877); No. 25 (Dec. 22); No. 26 (Dec. 29); XXXVI (Feb. 2, 1878); and XXXVI (March 9, 1878).

[31]Ibid., XXXVI (April 13, 1878).

[32]Ibid., XXXVI (May 25, 1878).

The size of the coal reserve rather proves that the Wildrose cutting and burning activity continued through much if not all of the winter, despite the smelter inactivity.

The exciting news promised by the Independent was apparently not the fact of smelter resumption, but discoveries of even more promising ore bodies at the Modoc Mine, including the discovery of deposits of "rich horn-silver, the native chloride of silver, or ceragyrite." Of even greater consequence, however, was the development of a tunnel which was supposed to lead to immense riches. By July 1879 this tunnel, at the level of "1000 feet below the ledge croppings" reached a length of over 1,700 feet. The editor of the Inyo Independent for March 29, 1879, considered that "by far the most important mining work now going on in Inyo County is the deep tunnel enterprise of the Modock Consolidated. It will develop our most prominent base metal mine at the greatest depth yet attained. . . . A strike is almost daily expected."[33] While it is possible that the results of all this effort were worth the expense, the absence of further reference to the tunnel or "the big strike" make it seem probable that this was a fiasco. The Modoc would carry on for many years yet, but it would never regain the rosy glow it gave off in the late 1870s.

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[33]Ibid., XXXVI (June 8, 1878); XXXVIII (Jan. 25, 1879); XXXVIII (April 5, 1879); XXXIX (July 5, 1879).

During 1880 there is ample evidence of activity at other mines near Darwin, including the Cerro Gordo, New Coso and Custer, but things were quiet at Modoc until July when the Independent noted that "Wood and coal hauling will commence in a few days and furnaces will be fired up about August 10."[34] Actually, the Modoc furnaces did not get started until December 10![35] As of January 22, 1881, the Modoc furnace was operating with a crew of 15 men. However, the successful run or processing of the ore promised to yield but 100 tons. This accomplished, the company told the Superintendent J. J. Williams "to resume prospecting."[36]

In May 1881, Frank Fitzgerald leased the entire Modock property at Lookout from San Francisco owners, likewise the Minneatta. The Independent announced that "he will put a force of men in the mines prospecting and developing and will in time make an extended run with the furnace." By September Fitzgerald had extracted 79 tons of ore. In November "preparations are being made to start up the Modoc furnaces" to process a total of about 200 tons of ore from the Modock and Minneatta, plus 15 tons of ore packed in by mule train from

[34]Ibid., XLI (July 24, 1880), citing Inyo Independent.

[35]Ibid., XLI (Dec. 11, 1880), citing Inyo Independent.

[36]Ibid., XLII (Jan. 29, 1881).

Panamint. As of December 22, "the Modock furnaces are in active operation . . . putting out bullion worth $600 to $700 per ton."[37]

Through 1882 and 1883 the Modoc mine and smelter was worked intermittently and with modest success under lessee Fitzgerald, sometimes referred to as "Little Fitz." In December 1883 came rumor of "an important new strike in the old Modock mine . . . Supt. Fitzgerald has a strong force at work preparing for a big run of the furnaces."[38] An official estimate of the situation at this point is given in the 1883 Report of the Production of Precious Metals in the United States:

> Modoc district, more generally known as Lookout district, lies south of Lee district and west of New Coso; formation, lime and porphyry. The most prominent group of mines in this district, and the best developed, is owned by the Modoc Company, a San Francisco incorporation. These mines were worked at a loss under the former management, but under the management of Frank Fitzgerald, the present lessee, they are a decided success. The principal mines of the company are the Confidence, Modoc, and Lookout, situated on the eastern slope of Lookout Mountain, near Panamint Valley, about 12 miles from Darwin. The mines have been extensively developed by shafts and tunnels, a large amount of ore extracted, bullion produced, and are at the present time being successfully and profitably worked. The company own two 30-ton smelters.
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> Coso district. This district lies south of Modoc and Sherman districts, in a short broken range of mountains. Formation, granite. This district was discovered by Dr. George in

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[37] Ibid., XLII (May 21, 1881); XLIII (Aug. 13, 1881); XLIII (Sept. 24, 1881); XLIII (Nov. 19, 1881); XLIII (Dec. 31, 1881) all quoting from the Inyo Independent.

[38] Ibid., XLIV (Feb. 11, 1882) to XLVII (Dec. 22, 1883).

1860, and created considerable excitement from the rich gold ores found at and near the surface in several small veins of quartz.[39]

The 1884 Report on Precious Metals, referring to the Modoc or Lookout District, describes the mines of Modock Consolidated as "the only mines which have received any development worthy of notice. . . . Large amounts of argentiferous lead ore extracted, assaying from $60 to $80 in silver. The company owns two 30-ton galena smelters; several successful runs have been made, and a large quantity of base bullion has been shipped for reduction."[40]

The 1890 Report of the State Mineralogist brings out the fact that "there are three smelters in this district, but they have not been run for several years. The ores of high grade that are extracted here are treated abroad, giving better financial results than if treated at home."[41] From this may be clearly inferred that the famous smelters were abandoned about 1885. It can only be inferred also that this would have been the latest possible date for the production of charcoal at the Wildrose kilns. However, it is probable that charcoal manufacture at Wildrose ceased long before this date.

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[39]Report on Production of Precious Metals in the United States (1883), 164-165.

[40]Report on Precious Metals of the United States (1884), 104.

[41]10th Annual Report of the State Mineralogist (1895), 210-211.

The only evidence available as to the terminal date, admittedly inconclusive, is that stump tree-ring analysis suggests no timber cutting in the neighborhood of the kilns after 1879.

Although the old kilns were obsolete, the Modoc continued its productivity at least until 1896, as clearly set forth in further reports of the State Mineralogist.

> Modock Consolidated Mining Company's Mines.--They are as follows: Confidence, Lookout, Modock, Keys, and Hearst. They are situated on the eastern slope of the Argus range, 15 miles S.E. of Darwin. At present they are being worked under a lease. The deposits are chiefly silver-bearing galena with a little gold, the inclosing rock being limestone. The deposits are generally in chamber form, though sometimes approximating the form of veins. A tunnel of 1,950 ft. long has been run to tap the deposits, the greatest depth reached below the surface being 1,150 ft. The best ore has been taken from this tunnel. It is said the ore carries 101 to 293 ozs. silver, 52 per cent lead, and less than ½ oz. gold per ton. Hornsilver and carbonates occur in limited extent. Lookout Hill, on which the mines are situated, seem fairly filled with chamber-like deposits of galena; many not showing on the surface. These mines were located in 1875, since which time it is said $1,900,000 has been taken out. Frank Fitzgerald, of Modock, lessee.[42]

> Modoc Consolidated Mining Co's Mines.--(See our XIIth Report, p. 24.) They are on Lookout Mountain, 15 miles S.E. of Darwin. Stoping is being done in the lower (No. 2) tunnel, which is 1,200' long, and where a large ore-body has been discovered lately. Frank Fitzgerald, of Modoc, lessee.[43]

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[42] Twelfth Annual Report of the State Mineralogist (1893-1894), 24.

[43] Thirteenth Annual Report of the State Mineralogist (1895-1896), 32. Mrs. Elodie Drew of Independence, California, is a knowledgeable descendant of Fitzgerald, according to Chief Park Naturalist Pete Sanchez.

A 1917 report of the California State Mining Bureau on mineral resources of counties east of the Sierra mountains lists "Modoc Mine (lead-silver), Lookout district, 30 miles north of Trona . . . elevation 3500 feet. Idle for many years." Evidently the Lookout district remained idle despite "the remarkable increase in value of the metals during 1915," the obvious result of industrial demands of World War I.[44]

Although the Modoc Mine is well outside Death Valley National Monument, as had been indicated, its close relationship to the Wildrose kilns makes it a valid object of visitors' interest. Nadeau suggests how the site may be reached by the venturesome:

> Lookout. Beginning in 1875 the camp of Lookout flourished in the Argus Range. It was connected by pack trail with its neighboring mines, the Mineatta and Modoc (the latter owned by George Hearst . . . .)
>
> Today's tourists find a remnant of this silver boom in the rock charcoal kilns of Wildrose Canyon in the Panamint Range. Their product was hauled by Remi Nadeau's mule teams across Panamint Valley for the smelters of the Modoc and Mineatta.
>
> For the traveler of today the Modoc and Mineatta may be reached by driving west on a dirt road from the main north-south highway through Panamint Valley (State 178). The Mineatta is located on the south side of Lookout Mountain, while the Modoc is in a deep canyon about a mile away on the east side of the mountain, and requires a short but steep hike from the end of the road. Reaching Lookout is even wilder, since it is

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[44]Fletcher Hamilton, Mines and Mineral Resources of Alpine County, Inyo County, Mono County. California State Mining Bureau, San Francisco (1917), 55, 83, 97.

perched on top of a mountain above the mines. It requires a hike of about 3 miles up an old mule trail from the Modoc, or a roundabout drive via the back of the mountain if you have a jeep. Located on the north slope of Eastern Lookout Mountain, it exhibits the remains of some 40 buildings in various states of decay, including half-a-dozen with all the walls still standing.[45] Today Darwin, in a desolate setting, is not quite in the ghost town category, with some latest mining and processing activity.

The Modoc site is right on the boundary of a Federal reservation identified as "U.S. Naval Ordnance Test Station." Darwin is at the end of a spur road off of State Highway 190 between Towne's Pass and Owen Lake. In 1939, according to the W.P.A. guidebook, Darwin, which sprang up in 1875 and once boasted of 1,500 people, was reduced to 75 houses, with some inhabitants involved in a Darwin Lead Mine. Water, being non-existent at the town, had to be hauled from Darwin Falls in the Coso Mountains, 8 miles away.[46] Today Darwin borders on the ghost-town category.

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[45] Nadeau, op. cit., 202. See also map and photographs. The Modoc complex on Lookout Mountain supplied through Superintendent Robert Murphy, Death Valley National Monument, and Richard Powell, Park Ranger at Wildrose.

[46] Federal Writers' Project, W.P.A., Death Valley, A Guide (Boston, 1939), 33.

THE STORY OF OLIVER ROBERTS

Only one eye-witness account of charcoal operations associated with the Modoc mine has been located and it is far from satisfactory for our purpose since it is long on episodes of wild conduct and short -- almost silent -- on specifics of the charcoal operation itself. As a matter of fact the narrator fails to mention, much less describe, the ten beehive-shaped kilns themselves, although these were built before he left the territory. He fails to throw any light on the "Mr. Morrison" identified above as the supervisor of the kilns' construction though he does mention Mr. Guptail (Guptill) who was a certified Modoc Mine manager in 1877-1878. He mentions a village -- the workers' living quarters and a store -- near charcoal pits, not kilns, which does not match up with Wildrose Canyon. He also mentions a tour of "Wildrose" which is unidentifiable but could refer to the later camp near the kilns The adventures he mentions may have future value in enlivening NPS interpretation of the rough life of those associated with charcoal-burning, but none of these adventures are clearly associated with the kilns themselves.

The contemporary actor in question was Oliver Roberts de la Fontaine, who shortened his formal name by dropping the "de la Fontaine." His story appears in a now rare book, The Great Understander: True Life Story of the Last of the Wells Fargo Shotgun

Express Messengers, compiled by William W. Walter, and published by this same Walter at Aurora, Illinois, in 1931. This is represented as the "true life story of Oliver Roberts . . . taken from his diary, and other writings." In his "Explanatory" Walter notes that "especial care has been taken to preserve the original wording of the narrative. NO attempt has been made to embellish, enlarge or exaggerate."

There are several odd things about this book. Instead of chapters, there are over 150 little episodes, almost none of which are dated. Although the sub-title emphasizes association with Wells Fargo, the fact is that there is only a brief fling with Wells Fargo near the finish; the bulk of the book relates to mining life in the vicinity of Panamint Valley. Finally, the main title is completely mystifying until one reaches the end of the book where, at the end of his life, Roberts takes up Christian Science; the title is evidently intended to cast a religious glow over Roberts' rowdy past, but it must be confessed that the effort is not convincing. In his youth Roberts was evidently one of the toughest characters in the California mines, and the violence and suffering here portrayed scarcely radiate spiritual qualities.

There is one other odd thing about The Great Understander. Either this same book or the manuscript of reminiscences from which it was copied re-appeared in an interminable series of articles in

The Pony Express (Placerville, California), between September 1950 and January 1955, edited by H. Hamlin. These were entitled "The Death Valley Kid," this being what Oliver Roberts was called, according to Hamlin, notwithstanding the fact that the term appears nowhere in *The Great Understander*. Hamlin writes: "The Reminiscences of Oliver Roberts, written in 1897, I ran across in San Francisco ten years ago (1940). The reason why this rare latent manuscript has lain dormant for over half a century is because the family did not think it should be published as written." Making no mention whatever of *The Great Understander*, Hamlin goes on to say, "Parts have been printed, but only parts, and these twisted and distorted beyond recognition of their having come from the pen of a pioneer." A comparison shows that "The Death Valley Kid" version is less polished and has a few more details about some episodes; however, it sheds no additional light on the substantive history of the Modoc-Wildrose operation; accordingly, the following resumé has been extracted from the book, which has been spared all of the editorial fanfare and purple prose in *The Pony Express* about this alleged "Kid Warrior of the Desert."

Roberts was born in October 1857 in Woonsocket, Rhode Island, of French-Canadian parents. His father had joined the California gold rush of 1849 and returned prosperous. He travelled again to California in March 1857, so was not present at the boy's birth. When he did return 4 years later his fortune was gone and his health broken. Because of impoverished boyhood circumstances, Roberts left his family, eventually going west to work on a Nevada railroad. While in Los Angeles he heard of boyhood friends living at Darwin, Inyo County, and he resolved to see them. Compelled to walk over 100 miles from the railroad station at Mojave, he almost died from heat and exposure before reaching his destination. Barely recovered from this ordeal, he was "hospitalized" again by a desperado who was in turn lynched by irate citizens. This sets the tone of Roberts' adventures:

> In about ten days all the bandages were removed from my face and head and I looked quite respectable. I could also walk very well now. A few days later, I went to work at one of the mines. About three months later, I received an offer of five dollars per day at a charcoal camp, about fifteen miles from Darwin. I was now nearing my seventeenth birthday, weighed about one hundred and forty pounds, and was strong and large for my age. As nearly everyone carried a gun, I was advised by some of my friends to get one and learn how to use it. I bought one and in a very short time, became a good shot and was very quick on the pull.
>
> Life was fast and very cheap at the mining camp and events followed in rapid succession. While in Darwin I met a man named Malloy from Woonsocket. I was warned that he was a very bad man but paid no attention to the warning and when I left Darwin for the coal camp, took him with me. He was a man about six feet tall, had black hair and mustache, was of slender build and of good appearance. His eyes were sharp and his lips thin. He always reminded me of a stage villain. He had been in jail and had deserted the regular army but I did not know this then.
>
> In due time we arrived at the coal camp. This camp was on the top of the highest mountain in that section of the country and was in a belt of pine-nut timber. The camp furnished charcoal for the Modock Lead Smelting Furnaces at Lookout, Inyo County,

> California. The charcoal was burned on the top of the mountain and packed on mules, to the foot, where it was loaded on wagons for Lookout. There were about three hundred men chopping wood and burning charcoal. There was a supply store where one could get clothing, hardware and provisions, wet and dry. I was made boss packer, and time-keeper. I had never seen a pack mule before. I was given a good mule to ride from one charcoal bin to another following up the charcoal and keeping tally on what went down the hill. I only kept the time of the day-laborers who were mostly Mexicans. They could not speak English, so I had to learn Spanish, which I did very quickly. I was doing fine and getting five dollars per day which seemed wonderful to me.
>
> It was not long before Mr. Lamontangue, one of the owners, asked me to take charge of the store and in this way earned three dollars more per day. I was delighted with the chance to make eight dollars per day. There was a spring near camp. It was the only one for several miles around and was owned by a young man who packed the water, on mules to the miners. This young man wanted to get away and he told me he would sell out his five pack mules and three water kegs for each mule, pack saddles, etc., for two hundred and fifty dollars cash, so I bought him out. I could sell the water for four cents per gallon, to the coal company, all winter and in the spring, I could sell to the coal burners. This would give me a nice revenue.[47]

After an unstated time lapse during which occurred various irrelevant adventures, Roberts writes, "the sheriff put the attachment on the coal company, the camp rapidly went to smash, and in a short time affairs were being settled up, and the camp was to be abandoned."

At this point it should be emphasized that, contrary to the loose assumption by H. Hamlin in his editorial comments as "The Death Valley Kid," the charcoal camp above described was definitely not the site

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[47]Walker, <u>The Great Understander</u>, pp. 69-71.

of the present Wildrose charcoal kilns. Roberts himself says the camp was 15 miles from the Modoc, whereas the kilns are 25 miles from the Modoc. (The camp was probably at a high point in the Argus Range or the Coso Range further west.) Further, mention is made only of pits, not kilns. Finally, although Roberts fails to provide us with dates, and his allegation of his being age 17 suggests 1874, the internal evidence is that he arrived in this territory in 1875 or 1876. It has been shown that Wildrose kilns were not built until 1877.

One of the horrendous episodes that follows was a gun battle at "Nadoe's Station" between our hero and a renegade named Belmont. This site and related trails shows up on the accompanying Inyo County map, along the Panamint Valley road. (See above for identification of Nadeau.)

Roberts subsequently did go to Wildrose Canyon, per instructions of "Mr. Guptail, Superintendent of the mine" because this is where the mining company was now chopping wood and making charcoal. "I was to take over some money and drive some men off the timber land belonging to the company on which they squatted." Roberts' first visit to Wildrose was under weird circumstances. In the lower part of the canyon he came upon a Shoshone Indian band who were torturing a young squaw to death by fire for alleged intimacy with a white man.

Because the Indians were in a bad mood, and he was outnumbered about 300 to 1, "The Death Valley Kid" wisely refrained from attempting to rescue the unfortunate red damsel. (The moral value distortion characteristic of Oliver's narrative is seen here: though he professes to have been horrified by this cruelty, he later refers facetiously to the event as "the barbecue.")

Next Roberts is sent by "Guptail" to Mojave with dispatches. (This aspect of the story dovetails with events described in the newspaper sources above):

> For some time past, the Modock Mine had not paid well. Ore was scarce and not very rich, and at this time, a tunnel was being run from just above the level of Panamint Valley into Lookout Mountain to tap the main body of ore. The tunnel was a heavy expense, but it would decide the fate of the camp and mine. If it struck no silver or lead ore, the camp was gone. If it did,--the camp was a boomer.
>
> Modock mining stock had been very low, on Pine Street, San Francisco, selling for almost nothing. Special assessments had been levied until the stockholders were about broke. On this morning, the tunnel had tapped a large body of black ore, very rich in silver. The miners were sworn to secrecy and were closely watched so they could tell no one and no one was allowed to enter the mine.
>
> Mr. Guptail, being a large stockholder, was nearly ruined, the continual call for "mud," a miner's name, for special assessments, made him anxious to get even with those who had depressed the company's stocks, and almost ruined him financially.
>
> When I started, he gave me two dispatches. One was an order to his broker to buy ten thousand more shares of stock, which was selling at a very low price on the market. After the

order for the stock was telegraphed and the stock secured, I was to send the dispatch, telling of the great strike of rich ore in the new tunnel.[48]

Returning from this mission for which he was paid $200, Roberts was hired by "Guptail" as a body-guard at $150 per month, plus $20 extra per fight. "That meant that some days I could earn from forty to sixty dollars per day." After disposing of a few bullies, Roberts modestly writes, "it became known that no more foolishness would be allowed in the mines."

Once again Roberts is sent across the Panamint Valley to Wildrose to drive squatters off the Modoc timber claim. He drives out three claim-jumpers by covering them with a rifle at daybreak, and setting fire to their log-and-brush cabin. There is only one further reference to Wildrose and that is mention of the rumor that "the Indians were preparing to raid the towns of Wild Rose, Lookout and Minnetta." (So Roberts supports the logical theory that with the concentration of wood-choppers and coal-burners there would be a village or settlement of some kind -- but we are left to guess just where this town was and what it looked like.) Naturally, with the Indian scare talk,

great excitement prevailed. There was talk of sending, to Fort Independence in Owens Valley, for soldiers but we all

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[48]Ibid., pp. 116-117.

knew that before word could be sent to Washington and an order secured to move soldiers, with their fifes and drums, everybody would be murdered. Reports began to come in that a great many Indians were gathering on high peaks of the mountains, for the last three nights. From this we knew there was a general call for all Indians for hundreds of miles around to gather.

At a meeting, called in Lookout for the purpose of making arrangements for our protection, I proposed that I go to the Indians and have a talk with them personally and try to learn their grievance. This proposition was laughed at and I was called a fool in very strong language and told that I would be killed at once.[49]

Roberts alleges that he (in company with the same Frank Fitzgerald who later became a lessee operator of the Modoc Mine) personally volunteered to seek out the Indians, who were full of complaints about the harvesting of pine-nut trees, the killing of Indians, the chasing of squaws and the stealing of jackasses. He did locate the Chief, parleyed with him and pacified him with a "gift of 5 'Jacks'" though sustaining an injured foot from a tomahawk thrown by a nervous warrior. Upon Roberts' return to Lookout the populace showed their joy at the "peace treaty" by exuberantly wrecking every saloon in town.

Later Roberts becomes "acting constable," practices extortion on the Chinese shop-keepers, has more gun-fights, and nearly dies from thirst and heat from crossing of Death Valley (being found near death at "the charcoal pile at the foot of Lookout Mountain," and

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[49]Ibid., p. 139.

rescued by a Mexican packer named Jesus). After joining Fitzgerald and others in a feud with "anti-workers" or "Molly Maguires," Roberts migrates to Bodie in the fall of 1878. (This date, coupled with dubious reference to his age on various occasions, constitutes the only chronological evidence.)

Roberts' later career included prospecting, mining, engineering and "experting." His travel took him to Alaska and he wound up living in California. His elderly role of Mason and dedicated Christian Scientist is in rather startling contrast to his wild youth.

To summarize, Oliver Roberts or (if you prefer the Pony Express version) "The Death Valley Kid" seems to have arrived in the Panamint Valley region about 1875 or 1876 and, on his own say-so, he left in 1878. He was involved in time-keeping and store-managing at charcoal pits of unidentified location. He also did some charcoal-hauling and once himself claimed "six hundred and forty acres of pine nut timber land for making charcoal." Some of this charcoal business related to pits in close proximity to the Modoc, some of it was in Wildrose Canyon, but there is no mention whatever of the Wildrose kilns per se. The claim-jumpers' cabin and the alleged village of "Wild Rose" may have been in the vicinity of the kilns; and archeological search might confirm something of the sort. Contrary to H. Hamlin, however, there is no evidence to link Roberts directly to the kilns and only two brief missions on behalf of Superintendent Guptill which link Roberts to the Wildrose operation. We can only say that he may have been around when the kilns were built and operating but, if so, he doesn't say so.

THE HEARST INTEREST IN THE MODOC MINE

One of the intriguing facets of the Wild Rose site is its association with George Hearst, famed mining engineer and U.S. Senator, and father of the yet more famous William Randolph Hearst. Many writers have always associated Hearst with the Modoc Mine, usually stating or implying that he was the chief owner and operator.[50] The Mining and Scientific Press item above referred to, the only one encountered in that source which mentions Hearst, makes it clear that he was an interested spectator in the smelting operation, but suggests nothing more than his frequent role as mine expert, paid handsomely for his advisory services. In the only George Hearst biography encountered, there is no mention whatever of his involvement with mining in Inyo County, California, but much is made of his expertise:

> After Hearst organized and developed the Homestake Mine his footsteps in the western mining world led from Dakota to the Cordillera. Often his assays of mines were quoted in schools

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[50]I.e., Burr Belden, Miners of Death Valley (Glendale, 1966), 18.

of mines. He was considered the best judge of mines in the world. He was so much in demand, his judgment was so often sought, that he had scarcely any private life. From the time of his great success he belonged largely to his career. William Randolph Hearst recalled him as always going and coming with valises full of quartz specimens.[51]

However, he did have an authentic interest in and at least an implied fractional ownership of the Modoc, for the California State Archives reveals George Hearst as one of the five directors of the "Modock Consolidated Mining Company," the articles of which were filed in August 9, 1875, with "principal place of business, San Francisco."[52] Three efforts were made to track down materials relating to the Modoc operation, which might conceivably be among Hearst family papers, or in surviving corporate records. The Bancroft library was approached about a reputed collection of Hearst family correspondence; Library Director Robert Becker assured the writer that his particular collection contained little on early mining ventures. According to Death Valley Monument personnel, Mr. William Lane, present owner of the Minnietta Mine, "knows one of the Hearsts in San Francisco." He has offered to try to acquire copies of pictures, maps and documents of historic value through Mr. Hearst.[53] This line of inquiry has been

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[51]Mr. & Mrs. Fremont Older, <u>California Pioneer</u> (Westernlore, 1966), p. 159.

[52]Letter of April 14, 1970, W. N. Davis, Jr., Chief of Archives, State of California, Sacramento, to Merrill J. Mattes.

[53]Letter of May 5, 1970, Richard C. Powell, Park Ranger, Wildrose District, to Superintendent, Death Valley.

unproductive to date. (An inquiry by the writer of the Hearst Corporation, San Francisco, drew a negative response; that is, no information available.) Finally, through Elisabeth Egenhoff, retired librarian of the California Bureau of Mines, the writer learned that the Modoc was taken over several decades ago by the San Luis Mining Company, 100 Bush St., San Francisco. An inquiry there elicited the information from Miss Jane Noland that San Luis took over from the Hearst Corporation and others about 1914. The Modoc Consolidated Mining Company itself was formally liquidated in 1965; some corporate records remain with the San Luis Mining Company.

APPENDIX

TECHNIQUES OF CHARCOAL MANUFACTURE AND CHARCOAL KILN CONSTRUCTION

Charcoal is a black, porous form of carbon prepared by charring wood or organic matter in a kiln or retort from which air is excluded. Charcoal produced from wood retains its basic shape and texture but is converted to a 96% pure carbon content.

In the 19th century and earlier charcoal was used for a furnace fuel because it burned more slowly than wood and created a much greater heat that was needed for the refining of ores.

Similar use of charcoal today is the small blacksmith forge for metal working. A more familiar usage is the char broiler in restaurants and "backyard barbecues".

Up until the mid 19th century the most common method of manufacturing charcoal was burning in a heap or pile called a "meiler." Oven or kiln produced charcoal became more common as the expansion of industry increased the demand for coal.

The kiln method produced greater yield from the same quantity of raw material and was manufactured in less time because it eliminated losses from changing atmospheric conditions and required fewer days to process than the meiler.

The major advantage of the meiler method was that it produced the coal at the site of the raw material whereas the kiln, being fixed in location, required transport of the timber to it.

Other comparative advantages and disadvantages could be mentioned. As in any commercial venture the decision as to which method would be employed was essentially related to economics. Some of the considerations affecting this decision were (1) local traditions of coaling and preferences of the available colliers, (2) geographic and climatic conditions, (3) types and size of forests, (4) labor supply, (5) required location of the furnace and methods of transportation.

Both systems will be described here with the meiler system first. There are many variations of this primitive method as might be expected since it is an international method of producing charcoal. The following illustrations depict the two basic meiler forms, "lying" and "standing". This discussion will concern itself with the commonly used type, the standing meiler.

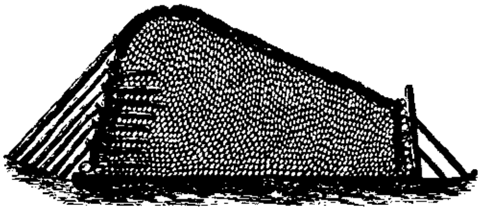

Fig. 1
Sectional View
Lying Meiler

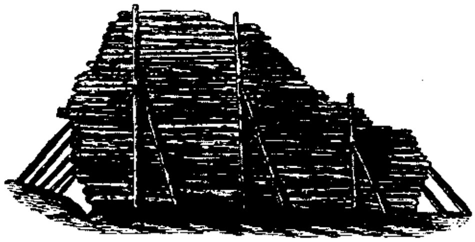

Fig. 2
Elevation View
Lying Meiler

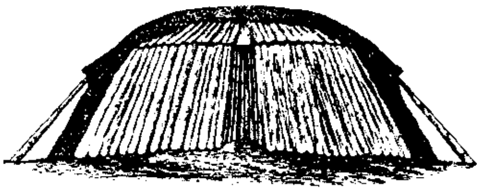

Fig. 3
Sectional View
Standing Meiler With
Chimney and Covering

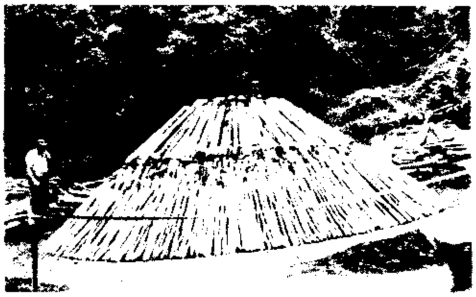

Fig. 4
Tiered Standing Meiler
Without Final Covering
Hopewell Village N.H.S.

Figures 1, 2 & 3. Taken from G. Svedelius, Handbook for Charcoal Burners, trans. R.B. Anderson (New York: 1875)

Figure 4 Photograph taken by A. Lewis Koue, Architect, H&HA, WSC

A meiler is, in fine, a lot of wood piled up or raised up according to certain rules on a so-called hearth, a place which has been cleared and levelled and is either flat or gently sloping. The heap of wood is thatched with charcoal dust, if this is at hand, but if not, with dirt, sawdust, and the like, in order to prevent in this manner the admittance of air, for otherwise the whole would, when kindled, burn to ashes. When the meiler has been thatched it is ignited at some certain point, which varies in situation according to the construction of the meiler. When the fire is well established, the place of igniting is carefully covered, but if the thatching is everywhere perfectly tight the fire will soon be extinguished, while it will be nourished more or less lively by a more or less liberal access of fresh air. Sometimes the covering is so thin that the necessary air can pass through, but more commonly, especially in standing meilers, it is necessary to make small openings in the covering for the air to pass through. Then the draught is so regulated that the oxygen entering may be just sufficient to burn what wood and charcoal is needed, in order that the coaling of the wood may progress gradually from the exterior to the interior; and in order that the development of gases may be kept steady by a well-regulated temperature. But for this purpose it is necessary to allow the nitrogen (constituting about three-fourths of the air) and the gaseous products of charring (carburetted hydrogen, carbolic acid, carbonic oxide, tar, etc.) to escape, and therefore openings are carefully made here and there in the covering. During the whole coaling process the draught should be so regulated that the outside air does not find its way to the red-hot charcoal, for in that case the latter is consumed. It first gradually grows porous and spongy, and finally goes to ashes. But we must not permit the smoke to pass out through the glowing mass of charcoal, for, as has already been stated, when the watery steam and carbonic acid come in contact with glowing charcoal, they consume it in course of time, and besides air is easily mixed with it. To prevent this we must stop the air-holes with a shovel in that part of the meiler in which the wood is already coaled, and open new air-holes,

> but always near where the coaling process is going on. In this manner the hot charcoal will be well protected by the covering, and will be surrounded by gases produced by the coaling process going on in near proximity to it, and containing no free oxygen. By all these means the charcoal that is cooling will be tolerably well protected from consumption. The fire and heat progress in the opposite direction to the draught, until the coaling finally ceases near the ground, which by its dampness and coolness stops the coaling, and makes it impossible to get every block of wood coaled; and hence, after the charring is complete, there remains not only thoroughly charred black charcoal, but also imperfectly carbonized charcoal in the form of lignites and brands.[1]

In constructing a meiler the first step is the selection and preparation of the hearth or meiler base. An improperly selected or prepared hearth which is not dry, solid, and free from draft will result in a poor quality charcoal no matter how well the coaling process is carried out.

The best location for a hearth is a slightly raised level area to provide good drainage. Sometimes the center is raised several inches and grade sloped to the outside to facilitate drainage within the meiler.

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[1] G. Svedelius, Handbook for Charcoal Burners, trans. R. B. Anderson (New York: 1875), pp. 27-29.

Trees should be cut after the sap falls and before its rise, generally from November through March. To speed up the drying out of the wood the bark and branches are removed and the tree placed in the sun. The seasoning normally takes one full summer so that the trees are cut one fall and coaled the next fall. Trees cut after the sap has risen will take at least two years to season and still can remain sour, producing a poor quality coal.

A standing meiler takes on the appearance of a truncated cone with a hearth diameter of 25 to 35 feet and a chimney height 8 to 10 feet, rising from the hearth center.

The chimney is formed by three poles securely fastened together forming an erect triangle, each side about 10". The best quality billets (prepared wood for coaling) are then vertically stacked against these poles as tightly as possible and placed continuously until the stack has a five foot radius. During the stacking of the billets all voids created are filled with fine wood and twigs to minimize air pockets which consume the charcoal and cause uneven coaling.

From this point outward the larger and poorer quality billets are stacked to the point where the outside layer will be placed. Since the butt end of the billet is placed on the hearth, the surface of the meiler takes on a conical shape.

Smaller seasoned billets are tightly placed to complete the coaling portion of the meiler. The cover consists of tightly placed branches and brush and a 4" to 10" air sealing cover of charcoal dust.

> When the charcoal dust has been put on, the meiler is ready to be ignited. This should be done in still weather and early in the morning, in order that we may have daylight for the first hours, in which the work is important and requires close attention. The fire may be made with charcoal or wood, but charcoal is better, since it is more certain to ignite and gives more heat, by which the drying of the hearth and the centre wood is greatly facilitated. The fire is kindled by making two or three pieces of charcoal red hot, then letting them down the chimney, after which we fill about one-third of the chimney with charcoal. It should be packed down well by the filling-rod, which takes its name from this operation, and when the charcoal is well ignited, the upper part of the chimney is filled in the same manner; and when all the filling is heated to a red glow, so that we may be sure the fire will not go out, we fill up again, if necessary, with well packed charcoal clear to the top, which is then closed up.[2]

Canals (openings at the foot of the meiler) are used to regulate the amount of air entering the chimney which allows the collier control over the rate of burning.

Closing of the chimney is accomplished by covering the opening with a large piece of sod followed with a cover of brush and loose coal dust. This will allow for the smoke and steam to escape along with a controlled draft.

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[2] Ibid., pp. 51-52.

As the chimney fill settles it is opened, recharged, and closed. This process is repeated as required until the meiler is completely kindled in about three days. The first step in the process involves forcing waters out of the wood through steam condensation.

> By afterwards putting a cap on the chimney filled with well packed fuel a great diminution of draught is produced, which now has to find its way through the charcoal dust, partly around the turf cap of the chimney, and partly through the covering itself. The result of this is that the products of combustion do not remain any longer exclusively in the chimney, but get into all openings between the billets, and partly mix with the atmospheric air found there, and partly press this air out before them through the charcoal dust covering. This is especially true of nitrogen, carbonic oxide, etc., products of combustion, that do not assume a liquid form at a low temperature; while other substances such as watery steam, tar-steam, etc., when mixed with the cold air and come in contact with the cold wood near the periphery of the <u>meiler</u>, condense in the form of water, tar, etc., which run along the wood to the hearth. In the same degree as the charcoal dust covering permits air, watery steam, and other substances to escape, new air is drawn in through the canals, and this air continues to be drawn especially to the bottom of the chimney, partly because the outgoing draught is strongest at this point where the fire is situated, and partly because in the very making of the <u>meiler</u>, its lower part is the most open, and therefore gives the least resistance to the pouring in of the air. After the fire and draught have begun to operate freely, the air enters both through the charcoal dust on the sides of the <u>meiler</u> and through the hearth, when this is not perfectly tight; and in this way we explain that the fire in the chimney may be sustained for some time, even when the canals are closed, and also that the draught is stronger in windy weather. Each of the several times, when the cap of the chimney is taken off for filling in new fuel, the

products of combustion are drawn more and more to the chimney, where they can escape unhindered, and when it is put on they spread again, especially in the upper parts of the meiler. Sometimes the fireplace in the bottom of the chimney is widened so that the wood around the lower part of the chimney is first dried, then coaled, and finally consumed. Above the fireplace drying and coaling progress as well of the fuel as of the meiler-wood lying immediately around it.

Although, in the nature of the case, the changes which now take place in the meiler from the time it is kindled until the whole coaling process is closed, are not distinctly separated from each other, we may still distinguish in the course of coaling three chief periods, of which the first is characterized among other things by the fact that the coaling process goes on only in the centre of the meiler in and around the chimney and moves almost cylindrically upwards, while in the second period the coaling takes more and more direct course to the sides of the meiler, until the upper part of the meiler is coaled, and during the third or last period the coaling proceeds from the already formed charcoal and round about the charred centre of the meiler like a cloak downwards and outwards to the foot of the meiler.[3]

Changes in Upper Part of Meiler

If the meiler has been properly made and the collier understands his business, the fire gradually spreads uniformly on all sides from the bottom of the chimney, whereby it cannot be avoided that a part of the charcoal produced by the billets is burned to ashes, the upper part of the meiler undergoes a much greater change. In the chimney itself the draught is upwards; thus it has the same direction as the combustion of the kindling-wood, and hence the combustion is more vigorous,

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[3]Ibid., pp. 56-58.

especially as the fire on its way upward always finds perfectly dry fuel. The degree of heat in the centre and upper part of the chimney, where the gaseous products of combustion coming up from below still contain a greater or less quantity of unconsumed atmospheric air (not considering the air, which finds its way thither more or less directly both from the canals and through the porous mantle of charcoal dust on the sides of the meiler), naturally grows high in a very short time. The drying as well as the coaling of the surrounding billets is here done quite rapidly and unhindered, wherefore also, in these parts of the meiler, the coaling takes a wider range than near the hearth. The charcoal produced is, however, on account of the main direction of the draught being through the already coaled to the uncoaled material, much exposed to further combustion.

What the collier here has to do is at each filling to push down with the filling-rod round about the meiler all the charcoal and wood lying loose therein, packing them well in the bottom of the chimney and then fill well again with new fuel, which must be packed as hard and tight as possible. If this is neglected, it easily happens that the fire makes its way too rapidly from the chimney to some of the sides, by which the coaling operation is very much injured and may become wholly unmanageable.

Sweating of Meiler.

The deposit of steam containing water and tar, etc., on the billets begins of course immediately after the meiler is kindled, but this dampness is not of much importance before the second or third day, when the meiler has become sufficiently heated in and around the chimney. We now say that the meiler sweats. This sweating also shows itself on the charcoal dust covering, which already, during the first twenty-four hours, begins to become damp, which dampness gradually increases during the next few days, then it decreases and finally entirely disappears. The time of its disappearance varies with the size and care of the meiler and the dryness of the billets. It may take place on the fourth or fifth day after kindling, or not before a week or more.

When the sweating of the covering ceases, this is a sign that the covering wood has for the most part become so thoroughly heated and dried that its coaling has already begun, and that the second period of the care of the meiler is entered upon.[4]

Smoke of Meiler

However important it may be in general to observe the character of the smoke coming through the dust, still this is especially important in judging of the farther advancement of the coaling process. At present, it must suffice to say that during the first days of coaling, the smoke, which then contains a large quantity of steam, is thick, heavy, and moves upward in puffs, while its color is a dirty, whitish gray, verging more or less on yellow; after which, just as the billets dry, and the water contained in the escaping gases is consequently diminished, the smoke gradually grows more transparent, thinner, lighter, and whirls up with great rapidity. In the beginning, nearly as long as only water escapes from the wood, the smoke is almost entirely free from smell; but, as the coaling of the wood grows more lively and extensive, the well-known peculiar smell, by which a coaling meiler is detected at a great distance, becomes more distinct.[5]

The second period, during which, according to what has already been said, the coaling progresses in a more horizontal direction from the chimney, may be assumed to begin about the time when the sweating of the covering has ceased. The billets have then become perfectly dry, and have everywhere reached at least the temperature at which the solid texture of the wood begins to yield, or in other words the wood begins to coal. It is, however, quite probable that before the dust has become perfectly dry, the covering wood nearest the chimney has already become more or less perfectly coaled. In the whole process of coaling no definite dividing lines can be drawn.

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[4]Ibid., pp. 59-61.

[5]Ibid., pp. 62-63.

Condition of Meiler at Beginning of Second Coaling Period.

The coaling being begun properly, the meiler will now contain the following solid parts: 1. A cylindrically or rather conically shaped layer of principally glowing charcoal, which near the hearth, if the meiler has been managed so as to heat it properly at the foot, extends 2 to 3 feet from the chimney into the surrounding billets. 2. Perfectly dry and partly charred wood, as well through the covering, where the wood has not been coaled, as around the coaled centre of the meiler. 3. A belt of more or less imperfectly dried billets. 4. An outside layer of billets, that are still quite green and sour. This layer is thinnest near the brow, where it begins, and thickest at the foot, where the most air enters and cools the wood, and where most of the water from the condensed steam is gathered.

The volatile substances found in the meiler are chiefly the same as have been mentioned before, but with this important difference, that watery steam now exists in a far less quantity than during the first days after igniting the meiler. We must also observe that the steam and gases in the covering and immediately beneath it now gradually assume a higher temperature, which certainly is not less than 216° Fahr., but may rise considerably above this; while, on the other hand, near the foot of the meiler, where a stream of cold air constantly pours in from all sides, the temperature may not be much higher than that of the atmospheric air.

Smoke-Vents.

During the first period of coaling it cannot be avoided that in and near the chimney quite an amount of charcoal is lost, remaining partly in the form of ashes, and partly in the form of weak, loose, half-consumed charcoal. The best proof of this is the severe task of filling, which recurs time and again, and for which 300 to 800 cubic feet of wood is consumed; and the reason of this is, according to what has been shown, that the draught is for the most part in the same direction as the coaling process. This is undoubtedly a great disadvantage in this method of coaling, but when the coaling, and if you please, the combustion has reached the upper part of the chimney, this disadvantage grows less perceptible, and when the work is well done, may, at the beginning of the second coaling period, and thereafter, be left without further consideration. For now the coaling does not progress any longer in the same direction as the draught, but rather in a more or less opposite direction. On the contrary, the more the coaling spreads outward in the covering, the more we must guard against the consumption of charcoal, which takes place if the warm steam and gases developed by the coaling process, on their way out, pass places where the coaling has just been completed, and where there is for this reason found red-hot charcoal. This may be prevented by making the dust as tight and impenetrable as possible, and by making with a stick so-called smoke-vents for the escape of the volatile substances produced by coaling. These smoke-vents should be made on the sides of the meiler a little below the place where the coaling is principally progressing. Finally, it is one of the most important rules that the temperature be kept as low as possible.

Regular Progress and Care of Meiler.

If the meiler has not been covered sufficiently the work may now begin by putting the required amount of dust on the covering, and packing the dust well and carefully down, especially on the upper part of the covering, over and round about the chimney. Sometimes, if the dust is very loose and dry, it is necessary to sprinkle the covering with water, in order to make it tight. When this is done, or while it is being done, the smoke-vents just mentioned above are made, which is called by the collier giving "the meiler a smoke." These vents are usually made 1 to 2 feet below the brow and about 2 feet apart. The most important duties of the collier during this second period of coaling are further: to watch carefully all the signs of coaling and in accordance therewith regulate properly both the smoke-vents and the canal openings, which, although diminished in number and size, are continued from the first coaling period. The collier must give these smoke-vents and canal openings proper size and situation, and must move and change them according to the progress of coaling, the weather, the quality of the hearth, etc. He must do all this in order that the coaling process may spread as uniformly as possible to all sides from the centre of the covering, and in order that the temperature in the meiler may not grow too high.

If he succeeds well in this, to which also belongs proper care of the dust covering, then he has scarcely anything more to do than possibly to take off the cap of the chimney once or twice a day and fill in with more fuel.

The rules for making the smoke-vents will be about the same as those heretofore given in regard to the canal openings, namely, that less or no smoke-vents should be made on that side where the coaling is inclined to get ahead, which may often be easily noticed by the settling of the meiler, and that, on the contrary, more and larger smoke-vents, sometimes in two rows, should be made on the opposite side. If the hearth is loose and open, or if the billets are fine and dry, or if the weather is cold, fewer smoke-vents are kept open. If the weather is very windy the smoke-vents are closed on the windward side; in case of a storm, the whole meiler is kept closed. All these rules need no other explanation than that the colder it is the heavier and denser becomes the outside air, and hence the draught through the meiler becomes stronger, as this depends upon the difference of weight between the outside air and the warm gases and steam developed in the meiler.

If the work has been well performed beforehand, and if the circumstances generally are favorable, it may happen that from the beginning of this period of coaling no farther filling is needed, but that the meiler gradually settles according as the wood shrinks and is coaled, and the collier has then only to pack down and keep perfectly tight the dust, so as not to permit the exit of the draught, where the wood has been coaled. The progress of the coaling by which he regulates the packing of the dust can be easily found, if not by the settling, then by the filling-rod.

During the time immediately following the making of the smoke-vents, while the latter are some distance from the parts of the covering, where the coaling process is going on, the smoke escaping through these breathing organs of the meiler is thick and opaque, verging on brown, but the more the coaling process advances downward and outward toward the brow, the thinner, lighter, and more transparent becomes the smoke, and when this thin, whirling smoke finally assumes a bluish color, then this is a sign that the coaling process has approached so near the smoke-vents that the last-formed charcoal is not perfectly protected from the gaseous products of coaling. At this point, which may be pretty well determined by the filling-rod, the old smoke-vents should be closed and new ones made lower down, and then begins the third or last period of coaling.[6]

The third or last period of coaling, in which it especially progresses from the covering outward along the billets, but at the same time also from the lower parts of the meiler, may be assumed to begin, when the covering has been coaled, that is to say, when the coaling has reached the brow of the meiler. The meiler, which has now settled considerably, if no irregularities have taken place, has about the appearance presented in Figure 3.

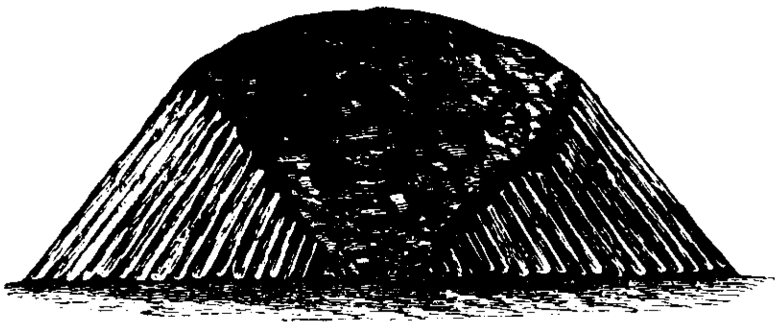

Fig. 3.

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[6]Ibid., pp. 71-76. The second coaling period lasts three to four days.

Half of its volume consists of a well settled mass of charcoal, having the form of an inverted frustum of a cone, the base containing more or less charcoal. The rest of the meiler is still wood. Near the charcoal this wood is perfectly dry, and contains some brands and some half-charred billets; but the farther out and down it is situated the more water it contains, and at the foot of the meiler it is yet quite green and sour.

The Care of the Meiler.

It is now clear that by making the canal openings and smoke-vents of the proper size and number, and by gradually moving the smoke-vents down, so that the smoke always may have its exit somewhat below the coaling process, and by observing generally the rules laid down heretofore, the collier has it in his power to protect almost perfectly the charcoal already formed from immediate contact as well with the air as with the gaseous substances developed by the coaling process, and also to keep the meiler in proper coaling temperature. Of course he must still and even to the end of the coaling look out that the latter may progress uniformly on all sides, and the fire does not get to one side sooner than to the other. This irregularity, always causing some loss of charcoal, is of less importance the nearer the coaling approaches the foot of the meiler.

No fillings are now needed, for in the same degree as the billets shrink and coal they settle by their own weight. Still the collier must not neglect to pound down with his shovel all coaled places and then pack the dust well down, which now frequently needs dampening in order to be able to give the necessary protection.

During the last part of the coaling process the collier must notice carefully the color and other qualities of the smoke, and move and regulate the smoke-vents accordingly. It has already been stated that the smoke-vents heretofore made near the brow must be moved down, when the covering is coaled, that is to say at the beginning of the third coaling period. When this is done, and if the smoke-vents are put in proper place, about ten inches below the line dividing the charcoal and wood (the place can be found by the filling-rod), and between the former smoke-vents, the smoke will in the beginning be again thick and puffy, of a grayish white color and strong smell, but the more the coaling progresses downward and approaches the new smoke-vents, the whiter and thinner the smoke grows again. When it afterwards assumes a bluish color mixed with white, the smoke-vents should be made smaller, in order that the draught may not become too strong; and when the smoke finally becomes light blue, the time has come to close the smoke-vents entirely and open new ones farther down.

And so the smoke-vents are moved, time after time, farther and farther down toward the foot of the meiler, observing, as has been stated many times, that in all those places where the wood is coaled, whether it be in the covering near the brow of the meiler, or farther down, the covering must be packed down without delay, in order to prevent, as far as possible, draught and the falling down of dust.

If the new smoke-vents be made too far below the coaling process, it easily happens that the coaling from the centre of the meiler outward proceeds too rapidly, so that the fire breaks out at some point below before the coaling from above has reached this same point. The smoke then assumes a brownish color, is very thick and opaque, and is called "brand-smoke," or "dangerous smoke," because the colliers know that it produces loss of charcoal. For now the air must pass through charcoal already formed, which is easily consumed, in order to reach the uncoaled wood above: for obvious reasons, a good share of this wood will make only poor charcoal and brands.

The more rapid or slow progress of coaling depends principally upon the size and number of the smoke-vents, and this must be left to the judgment of the collier, who must bear in mind that the larger and drier the billets, the longer time for coaling is required.

Some authors, and among these Uhr, require two rows of smoke-vents, some distance from each other, but this cannot be generally recommended, since then it readily happens that charcoal still glowing is exposed to injurious contact with the air and meiler-smoke.

When the coaling by moving down the smoke-vents, which should be gradually increased in number, reaches the middle of the lower part of the meiler, the number of the canal openings, which has heretofore been small, should be increased. If the coaling has proceeded regularly, these canals are opened uniformly all the way round, 6 to 8 feet apart; but if the coaling is uneven, more canals should be opened on the side where the coaling is behind. These openings are moved and made larger or smaller, according to the demands of the coaling, and toward the close their number is increased still more, so that they will not be more than 2 to 3 feet apart. For the lower part of the meiler needs a stronger draught, the wood near the hearth always being greener and sourer. Yet even now we must take care not to go too far in opening canals, but only so far that the coaling progresses freely and unhindered without going too fast. Finally, most of the dust is shovelled off the ends of the billets, in order to facilitate a more even coaling of the exterior. When the fire appears round about the foot of the meiler, the coaling is done. Now the exterior brands at the foot are removed, after which this part of the meiler is covered again with newly sifted dust, the whole heap of charcoal is packed well and left to cool.

If the coaling has been regular from beginning to end, the meiler will settle uniformly on all sides, and the fire will go out simultaneously everywhere at the foot. The meiler preserves during the whole process a uniformly rounded form, which is the surest evidence of careful management and successful coaling.

If the work is done properly and the wood is tolerably dry, it generally takes about three weeks to coal a meiler large enough to produce 35 Swedish lasts of charcoal.[7]

The final stage, removal and storage of the charcoal, can be accomplished in many ways but caution in the handling is the watch word for the loss of coal can be great.

> The removal, must, however, never be done immediately after the coaling is finished, while a part of the charcoal is still red hot; but the meiler should always be left one or two days, although, if the hearth is very loose, never longer. During this cooling period the dust covering should be increased and well packed, in order that the meiler may be kept as air-tight as possible, and it should never be left without care. In removing the meiler, which should not be done in windy weather, a sufficient quantity of water should always be kept at hand to extinguish the charcoal, which is still glowing when it is taken out, and to dampen the dust, which every time any charcoal is taken out, is thrown on again, to keep the rest of the meiler tight and free from draught.
>
> Finally, the charcoal taken out should not be stored away immediately, before we are certain that it does not contain any fire. This can be seen best at night, and hence the night is the best time for the kind of work which we are here describing.
>
> The second principal rule is: Not to use more water when we remove the meiler than is actually needed to quench the fire in the burning charcoal. To pour water in large quantities over the charcoal, and even over that which does not contain any fire, is very injurious, for in that way we get sour charcoal,

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[7] Ibid., pp 78-83. A swedish "last" is 75.6 cubic feet. Therefore the 35 lasts equalled 2,650 cubic feet.

which, on account of its moisture, has less value than dry charcoal; besides, it is heavier to transport, and in case of frost it freezes and is broken down into dust.

Finally, in the third place, we should avoid everything that may tend to injure, break, or waste the charcoal. Then in removing the charcoal we should not use a shovel, but a light meiler-hook, handled with care, with a rake and a basket or box. To hack into the meiler with a heavy meiler-hook, and thus bring the charcoal out, or to break it out with a handspike, or other heavy tool, must be strictly forbidden. All tramping and climbing on the removed charcoal should likewise be avoided, wherefore the work is generally done better by a few men than, as is often the case, by a lot of men and boys crowding each other. A considerable quantity of charcoal may be lost, if we neglect, before removing the meiler, to sweep the place around the meiler free from snow or dust—that is, where the charcoal is to be put. Removal during rain or snow should only be done when absolutely necessary.

It is of special importance that the charcoal, as soon as we are sure that it does not contain any fire, be piled up and stored away in such a manner that it is protected from bad weather, until it is transported to the place where it is to be used.[8]

The above discussion was concerned with the primitive meiler system of charcoal manufacture as practiced primarily in Europe; however it was practiced also later to some extent in the United States.

Dr. T. Egleston, School of Mines, New York City, presented a paper titled "The Manufacture of Charcoal in Kilns" at the May 1879 meeting of the American Institute of Mining Engineers in

[8] Ibid., pp. 84-85

Pittsburgh, Pa. Parts of this paper are quoted here to describe this more advanced form of charcoal manufacture.

> The manufacture of charcoal in kilns was declared many years ago, after a series of experiments made in poorly constructed furnaces, to be unprofitable, and the subject is dismissed by most writers with the remark that in order to use the method economically the products of distillation, both liquid and gaseous, must be collected. It is asserted with truth that the number of kilns required for a large production of iron would be so great that it is doubtful whether any works would be justified in making the necessary outlay for their construction, but it can also be asserted with equal truth that for any such production in a given locality the use of charcoal as fuel would be equally unjustifiable. It appears to have been forgotten that there were other manufactures besides iron in which large amounts of charcoal were used, but these consumers seem to have been guided entirely by the results of the experiments of the iron men who necessarily made the largest quantity of it. Some authors speak in a doubtful way of the quality of the charcoal produced, and a few concede that with great care good charcoal can be made in kilns, but that most of the workmen do not like kiln charcoal. This is the real secret of the opposition to this method of manufacture.
>
> Most of these objections were written when charcoal was the most important fuel used by the iron manufacturer, and when what was a large production of iron for several furnaces was less than that produced by a single modern one, in localities where other fuels can be had. Almost all that has been written on the subject related to the use of the fuel for the manufacture of iron in the blast furnace, where very peculiar properties are required, and where the quantity produced is limited by the height of the furnace, and this in turn by the crushing resistance of the charcoal. A large production was, therefore, only possible when the best and hardest woods

were used. Of all these objections there is not a single one which is not equally applicable to any method of charcoal manufacture, whether it be meilers, pits, or furnaces. Until recently, therefore, the manufacturers of charcoal iron have considered meiler or pit coal superior to kiln-made coal, but the manufacture of this latter kind of coal has been so much improved of late years that it is sometimes difficult for the advocates of meiler coal to distinguish the difference between the two. Occasionally the question of the sale of the accessory products was a factor. It is generally agreed that kilns give a better yield than meilers, but it is objected that the charcoal is not so strong for blast-furnace use. For other uses there does not seem to have ever been much question. Whether it will or will not be worth while to manufacture the accessory products will be determined by varying commercial conditions.

The question of pit or kiln coal was formerly settled by the cost of transportation. When transportation was low, kilns were used, the advantage of output being greatly in their favor, since the kiln can be burned slow or fast to make the coal of requisite density. The yield of charcoal is also greater in the kiln than in the meiler, it being from 45 to 50 bushels to the cord in the kiln, and from 30 to 35 bushels in the meiler. The amount of labor in using the kiln is also less. To counterbalance the increase in yield, the decrease in labor, the security against accident, and the celerity of the operation, the cost of transportation will have to be high.

Besides this the kiln is always under complete control, and can be examined by the burner at any time, and the exact condition of every part of it can be ascertained at every step in the process. As there is only an approximate knowledge and control of the meiler, the kiln should give the best product. The possibility of a large output is, however, the <u>ignis fatuus</u>

of modern metallurgy. The kilns are "turned" so often that the charcoal is burned too rapidly, and the quality becomes poor. In the desire to have but few structures to take care of, and to have the largest possible furnace capacity with the least expense, the kilns have been made too large. Experience has shown, however, that it is more economical to use kilns of small capacity, and that the increase in the cost of the structures is more than compensated by the increase in the quality of the product; while with large kilns the diminished cost of the plant is dearly purchased at the expense of a diminished yield of coal, and by the relatively poor quality of the product.

There seems to be no doubt that, given the peculiar conditions necessary for the construction of permanent works, the charcoal manufactured in kilns is cleaner, since it is free from the sand of the cover of the meiler, and is also denser if the process is conducted slowly. The yield is at least from fifteen to twenty per cent. more, and the expense is at least one-third less. In addition to this, as the meilers are at a distance, there is a loss of charcoal in transportation amounting to ten to fifteen per cent., so that the total gain in kiln manufacture is from twenty-five to thirty per cent. If the process was conducted as slowly, there is little doubt that the kiln coal would be equal if not superior to the meiler coal.

The only valid objection to kilns is their permanent character. In order to avoid the great cost of transporting all the wood these works must generally be situated in a country where there are streams or lakes which can be utilized for rafting or floating, or where the cost of carriage is very low, as the cost of transportation must be borne by only a small part of the material transported. But, as we have said, there are very few localities suitable for metallurgical manufactures where the interest and sinking fund on the permanent investment and the cost of transportation will overbalance the diminished cost of manufacture and the increase in the yield.

Charcoal has been studied almost exclusively in view of the manufacture of iron in the blast furnace. It is generally conceded now that it will not be much longer used on a large scale for that purpose. Less attention is, therefore, now paid to it than its merits as a furnace fuel warrant. There are districts where no other fuel can be had, and there are processes in which it must be used so long as they exist. For making blooms direct from the ore kiln charcoal is almost universally used. As between hard and soft woods the impression among the workmen seem to be that the quality of the iron made with soft wood is better than that made with hard wood, but the consumption of the softer fuel is greater. There are besides some ores of iron of exceptional purity, but so lean that they can hardly be worked in the blast furnace. To be worked at all they must be crushed and dressed, and it is only practicable to treat the fine ore thus produced in a bloomary with charcoal. In such districts the kiln has a peculiar importance, as it gives a charcoal free from dirt,—a very important consideration, as the whole object of dressing the ores is to get rid of the silica, and if dirt were introduced in the fuel the loss of iron would not only be increased, but the benefit derived from dressing the ores very much diminished.

As there are many silver districts in the West where coke cannot be had at such a price as will allow of its being used, and where the ores are of such a nature that wood cannot be used in a reverberatory furnace, the most economical method of making charcoal is an important question.

Kilns for the manufacture of charcoal are made of almost any shape and size, determined in most cases by the fancy of the builder, or by the necessities of the shape of the ground selected. They do not differ from each other in any principle of manufacture, nor does there seem to be any appreciable difference in the quality of the fuel they produce, when the process is conducted with equal care in the different varieties; but there is a considerable difference in the yield and in the cost of the process in favor of small over large kilns. The different varieties have come into and gone out of use mainly on account of the cost of construction and of repairs. The object of a kiln is to replace the cover of a meiler by a permanent structure. Intermediate between the meiler and the kiln is the Foucauld system, the object of which is to replace the cover by a structure more or less permanent, which has all the disadvantages of both systems with no advantages peculiar to itself.

The kilns which are used may be divided into the <u>rectangular</u>, the <u>round</u>, and the <u>conical</u>, but the first two seem to be disappearing before the last, which is as readily built and much more easily managed.

All varieties of kilns are usually built of red brick, or, rarely, of brick and stone together. Occasionally refractory brick is used, but it is not necessary. The foundations are usually made of stone. There are several precautions necessary in constructing the walls. The brick should be sufficiently hard to resist the fire, and should therefore be tested before used. It is an unnecessary expense to use either second or third-quality fire-brick. As the pyroligneous acid which results from the distillation of the wood attacks lime motor, it is best to lay up the brick with fire-clay mortar, to which a little salt has been added; sometimes loam mixed with coal-tar, to which a little salt is also added, is used. As the principal office of this mortar is to fill the joints, special care must be taken in laying the bricks that every joint is broken, and frequently headers put in to tie the bricks together. It is especially necessary that all the joints should be carefully filled, as any small open spaces would admit air, and would materially decrease the yield of the kiln. The floor of the kiln was formerly made of two rows of brick set edgewise and carefully laid, but latterly it is found to be best made of clay; any material, however, that will pack hard may be used. It must be well beaten down with paving mauls.

The centre must be about six inches higher than the sides, which are brought up to the bottom of the lower vents. Most kilns are carefully pointed, and are then painted on the outside with a wash of clay suspended in water, and covered with a coating of coal-tar, which makes them waterproof, and does not require to be renewed for several years.

The kilns were formerly roofed over with rough boards to protect the masonry from the weather, but as no special advantage was found to result from so doing, since of late years they have been made waterproof, the practice has been discontinued.

The wood used is cut about one and a fifth meters long. The diameter is not considered of much importance except in so far as it is desirable to have it as nearly uniform as possible. When most of the wood is small, and only a small part of it is large, the large pieces are usually split, to make it pack well.

It has been found most satisfactory to have three rows of vents around the kiln, which should be provided with a cast-iron frame reaching to the inside of the furnace. The vents near the ground are generally five inches high, the size of two bricks, and four inches wide, the width of one, and the holes are closed by inserting one or two bricks in them. They are usually the size of one brick and larger on the outside than on the inside. These holes are usually from 0.45 m. to 0.60 m. apart vertically, and 0.80 m. to 0.90 m. apart horizontally. The lower vents start on the second row of brickwork above the foundation, and are placed on the level with the floor, so that the fire can draw to the bottom. There is sometimes an additional opening near the top to allow of the rapid escape of the smoke and gas at the time of firing, which is then closed and kept closed until the kiln is discharged. This applies mostly to the best types of conical kilns. In the circular and conical ones the top charging-door is sometimes used for this purpose. Hard and soft woods are burned indifferently in the kilns. Hard-wood coal weighs more than soft, and the hard variety of charcoal is usually preferred for blast furnaces, and for such purposes there is an advantage of fully 33-1/3 per cent. or even more in using hard woods. For the direct process in the bloomaries soft wood charcoal is preferred. It is found that it is not usually advantageous to build kilns of over 160 to 180 cubic meters in capacity. Larger furnaces have been used and give as good a yield, but they are much more cumbersome to manage. The largest yield got from kilns is from 50 to 60 bushels for hard wood to 50 for soft wood. The average yield, however, is about 45 bushels. In meilers two and a half to three cords of wood are required for a hundred bushels, or thirty to forty bushels to the cord. The kiln charcoal is very large, so that the loss in fine coal is very much diminished. The pieces usually come out the whole size, and sometimes the whole length of the wood.[9]

The following plates illustrate the method and size of construction usually found in rectangular and round kilns.

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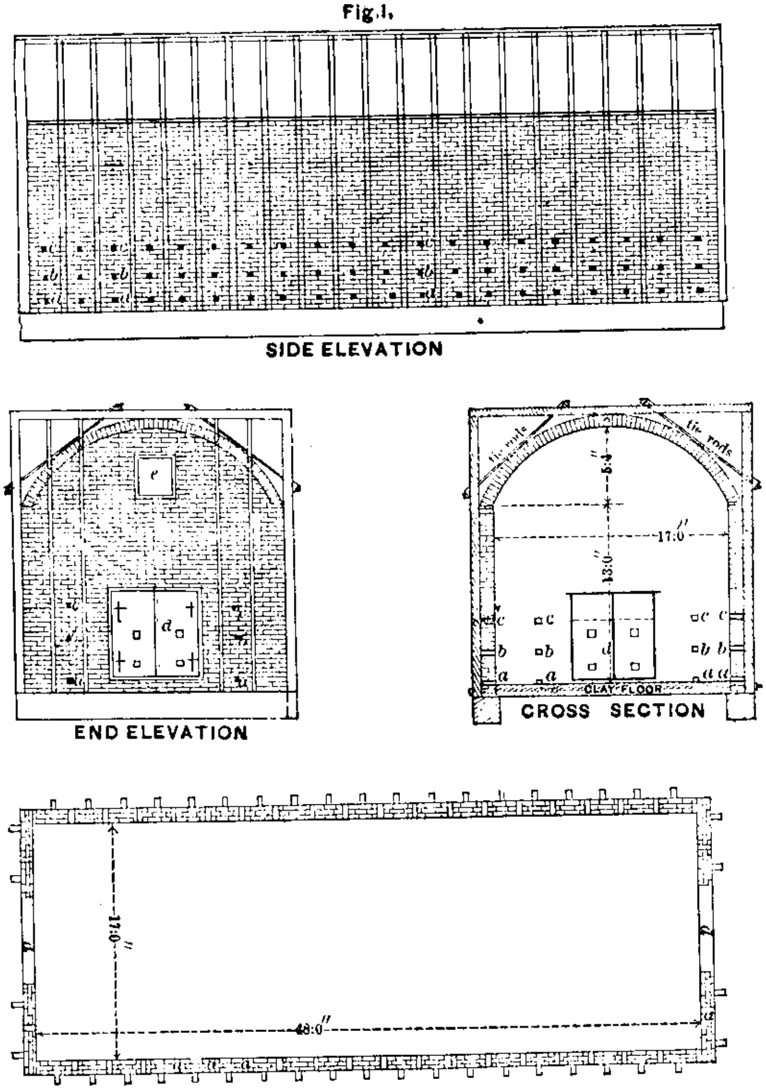
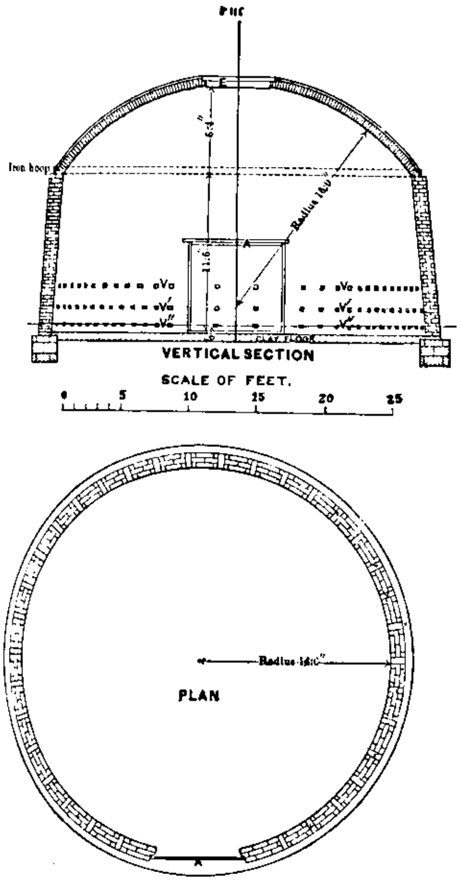
[9] T. Egleston, "Manufacture of Charcoal in Kilns," Transactions of American Institute of Mining Engineers (May 1879-February 1880), pp. 373-378

Fig. 1.


SIDE ELEVATION
END ELEVATION
tie rods
5:4"
17:0"
13:0"
CLAY FLOOR
CROSS SECTION
17:0"
48:0"
PLAN



CIRCULAR CHARCOAL KILN

Fig.5 A.

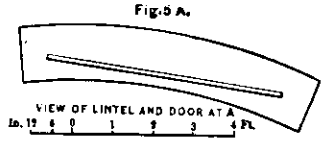
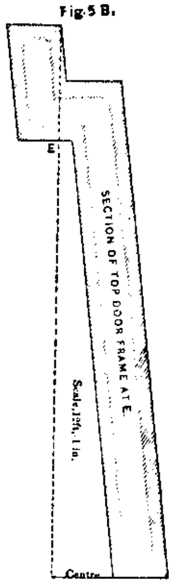


Fig.5 B.



The chief objection to the rectangular and round kilns is their want of stability. The rectangular kilns require to be braced with wood and iron, while the circular kilns, which offer no advantages over the rectangular, must in addition be hooped with iron. This makes this kind of structure expensive in the first place. The less expensive structure, Fig. 5, does not last much longer. The contraction and expansion which the bracing is intended to prevent does take place, and after a time there will be numberless air-channels in the shape of cracks in the walls, which cannot be effectively closed, which will both increase the difficulty of management and decrease the yield in charcoal.

Kilns of this shape are being rapidly given up. It has been found much more economical to construct and to manage small conical kilns than large round ones, and these conical kilns are gradually taking the place of the large ones of other shapes.[10]

The conical kilns are generally smaller than either of the varieties. They are usually from twenty to twenty-five feet high, and from twenty-five to thirty feet in diameter, and are intended for twenty-five to forty-five cords of wood. They are constructed in such a way as to require no bracing of any kind. They are often built into the side of a bank, a part of the earth of which is removed so as to make a charging-door near the top on a level with the ground; or they may be built on a plain, in which case there is no upper door, but only a charging-hole in the top, which is reached by a ladder in order to close it.

The usual dimensions of these kilns are:

	Diameter at base. Feet.	Height. Feet.	Capacity. Cords.
American Fork Cañon, Utah	26	20	25
Norton's Iron Works, Plattsburg, N.Y.	30	20	35
Wassaic, N.Y.	30	23	40
Readsboro', Vermont	28.6	28	45

[10] Ibid., p. 389.

There are three types of this kind of kiln, shown in Figs. 6, 7 and 8. 1. That at Readsboro', Fig. 7, in which the top of the cone is at a different angle from the bottom; there are two doors of the same size for charging. 2. That at Wassaic,

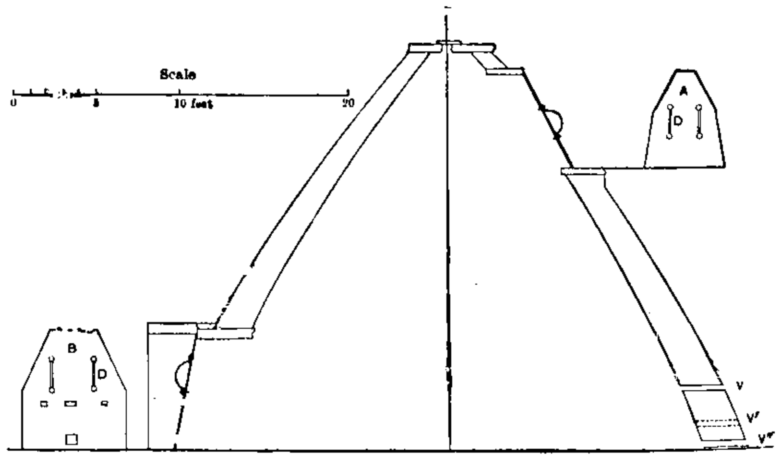


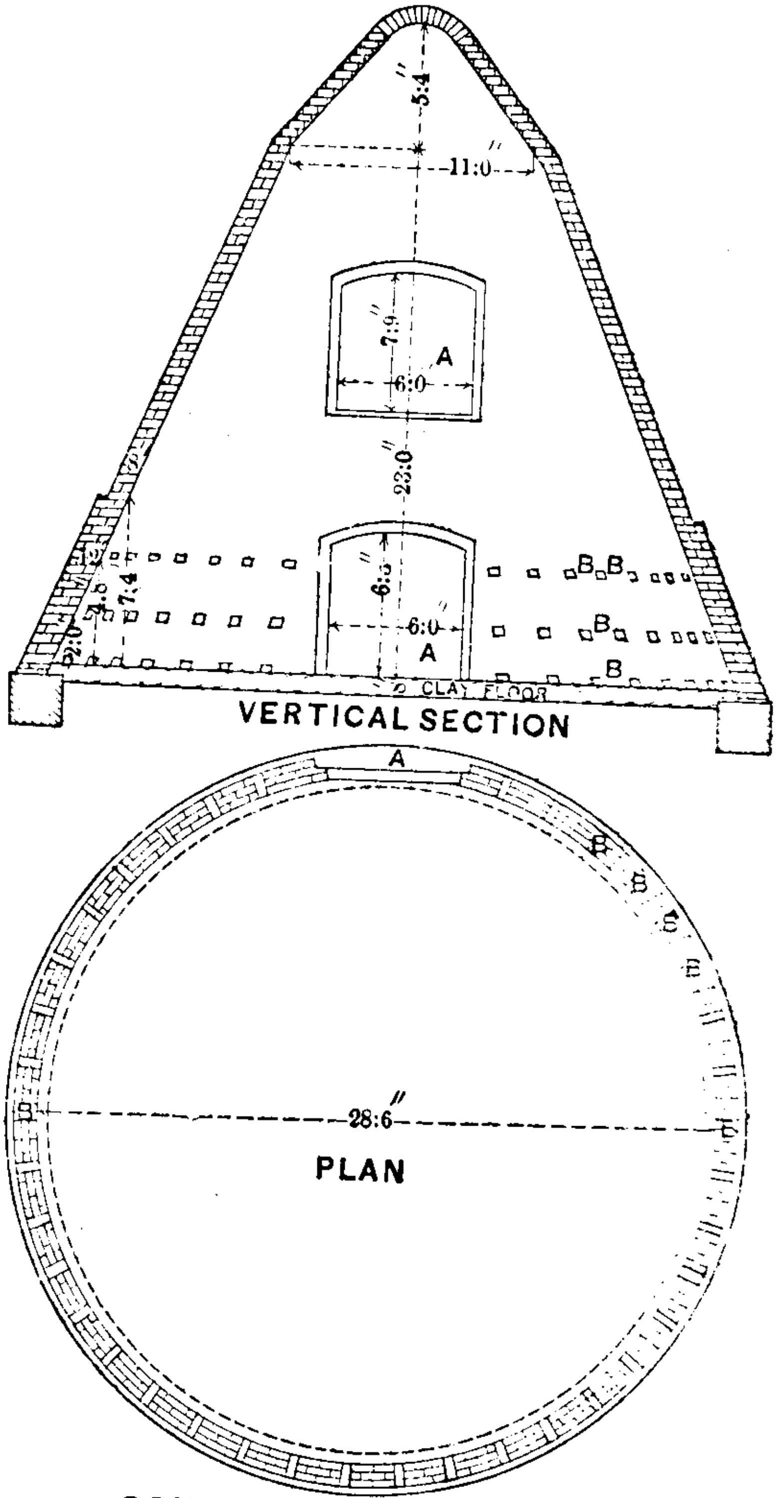
Fig. 6

Dutchess County, N.Y., Fig. 6, in which the cone has but one angle; there are two charging doors of slightly different size, and a hole in the top of the kiln to be used in firing. 3. That at Plattsburgh, No. 8, in which the conical form is the same throughout; there are two charging doors, one below, and the other in the top of the kiln. This last form is on the whole the best of all, being the simplest in construction and easiest to manage.

At Readsboro', Vt., Fig. 7, the walls are 12 inches thick at the bottom, but at a height of 7 feet 4 inches they diminish to 8 inches. From this height upward all the bricks are laid in headers. At the height of 23 feet the kiln is capped by another cone, which is 5 feet 4 inches high, and of much flatter angle. The details of construction are different in different localities, but the principle of all the kilns is the same. At Wassaic, Fig. 6, the walls are made 30 inches thick at the bottom, diminishing gradually to 11 inches at the top, which is made flat for a cast-iron vent-hole. On one side a doorway, 7 feet high and 6 feet wide, is built out, into which a sheet-iron door fits against flanges made for the purpose. On the line of the American Fork Cañon Railroad the bottom walls are carried up vertically on the outside to a height of 5 feet, where there is an offset. At the bottom the walls are 18 inches thick; at the offset they diminish to 1 foot in thickness. The interior is, however, conical throughout. The foundations are of the same thickness as the lower walls, and, as they are in earth, are 10 feet in depth.

At Norton's Iron Works, near Plattsburg, N.Y., Fig. 8, the wall is built with a batter of 3 inches to the foot up to 6 feet. At this point, the height of the kiln being determined as 20 feet, a perpendicular is raised, and somewhere on this line a centre is found from which an arc of a circle will meet the flange of the charging hole at the top, which is made of a cast-iron ring 4 feet in diameter and 8 inches deep, projecting 6 inches over the top. This makes the wall a little thinner at the top than the bottom. The flange of the ring is normal to the curve of the masonry, which is generally built of red brick. (Fig. 8 shows the way this kiln is constructed.) Sometimes the kilns are made of stone, which need only be strong enough to resist the low heat of the operation. Constructed in this way the kiln requires no braces of any kind. When the kiln is built against the side of a hill, the upper charging door is generally made of the same size as the lower one, but in Utah it is only 4 feet square. These doors usually have iron frames. Sometimes the upper part of the door-frame is directly under the top of the cone, as at Wassaic, Fig. 6, and in Utah; the lower one is then on a level with the bottom of the excavation made in the side of the hill. Sometimes the upper door is much lower, as at Readsboro', Fig. 6, and is connected with the woodyard by means of a bridge. At Plattsburg the kilns are built on a plain and the top opening is then reached by ladder. The discharge door is square, and has a cast-iron frame 6 feet high and 4 feet 6 inches wide. It is best to put in at the top of this door-frame a rod 3/4 of an inch in diameter, to prevent the tearing of the wall by expansion. The door itself may be in one or two pieces.

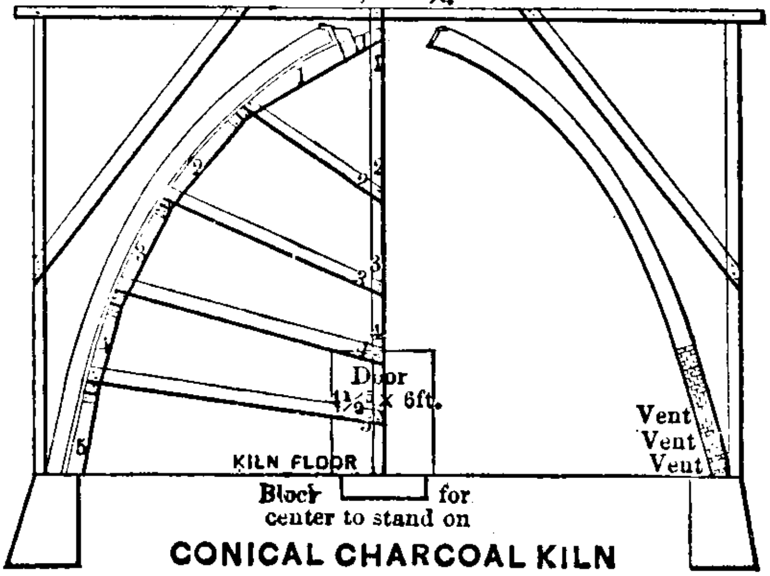
Fig.7.



CONICAL CHARCOAL KILNS

Fig 8

Scale, 4ft. = ¼ in.



CONICAL CHARCOAL KILN

It takes 33 M. brick to construct the Plattsburg kiln. About 40 M. brick to build the one at Readsboro'. The floor of the kiln is very nearly level, and on the sides comes up to the bottom of the lower tier of vents. It is usually 4 inches higher in the centre than at the sides. It is generally made of clay 8 to 12 inches thick, and must be well beaten with mauls and very carefully tempered. The kiln has three rows of vent-holes, which usually commence on the level ground. They start on the second row of brickwork above the foundation; the floor or hearth is brought up to this level. These vents are from 2 feet 6 inches to 3 feet from centre to centre. In some kilns the vents are arranged in quincunx, so that the upper and lower rows have 24 vents, the middle one 26. In others they are one over the other, sometimes as many as 40, and the same number in each row. In most kilns these openings are at equal distances apart, which is usually 18 to 20 inches. At Wassaic, Fig. 6, they are not spaced equally. The lower ones are generally on a level with the ground. They are five inches, or the height of two bricks, high, and 4 inches, the width of one brick, wide. The vents should be made of cast iron, set into the masonry. They are made tapering very slightly, largest on the outside.

It is always wise to use cast-iron vents. If no protection to the brick is used the pyroligneous acid attacks the mortar, which falls first around the brick and then above it, and in this way cracks of considerable size may be formed in the mortar around the bricks which it is almost impossible to fill. The additional cost of the cast-iron vent-hole is about $75 to the kiln, but it will save more than this in the cost of repairs in a few years. The cast-iron effectually prevents the action of the pyroligneous acid on the mortar. In the best kilns there are three to four bricks between each vent.

Each kiln is usually constructed to hold 35 cords of wood, solid measure. This is intended to yield 1750 bushels, which is 50 bushels to the cord. Either soft or hard wood can be burned; the former is generally used in the manufacture of blooms, and is preferred by many workmen.

To charge the kiln, skids two inches in diameter are laid 3 feet apart, keeping the ends up to the outside. They must be placed in the radii of the circle, for if the smoke is at all confined it will cause an explosion. The wood used is cut 4 feet 8 inches long, and is of all sizes from four inches up to two feet in diameter.

A fireplace, or chimney, four feet square, is made in the centre of the kiln, and carefully preserved in the filling to the top. An air-channel is made from it to the opening in the lower door. This is filled with shavings, brands, and lightwood, thrown in loose, which when the kiln is lighted is fired with a long pole from the door.

At the Norton Iron Works at Plattsburg, N.Y., the charcoal for the blast furnace and for knobbling fires is made of slabs, butt ends of logs, and flood-wood. This is brought to the kiln in a hand-cart that holds about half a cord. The bottom of the kiln is prepared as usual. Butt ends of logs are piled just above the top vents, slabs are put in up to six feet, then flood-wood about four feet long is placed, until it is no longer convenient to handle it; the filling is finished with blocks or butt ends of logs.

It takes four men about twelve hours to fill the kiln. When the kiln is ready to light, the upper door is closed and luted, but the lower one is left open until the kiln is lighted. Bricks are placed loosely in all the vent-holes; sufficient air comes in around them to light the wood. The fire is lighted with a torch through the channel prepared for the purpose. Four vents on each side of the door are then closed and luted; the others are closed as it is necessary, with a loose brick. The firing is always done at night. At the end of thirty-six hours a little air is let in by the vents near the door. The operation is conducted by means of the vents, which are carefully watched. The smoke will be white from three to four days. It will then become yellow in from 12 to 36 hours, and then will be blue for about 12 hours. When the smoke is blue at the top vent, it is allowed to remain open for twelve hours, and is then closed. In another twelve hours the second row will blue up, when that is closed. The bricks are finally drawn out of the lower vents; the fire then comes to the bottom, and when ready they are closed.

If the smoke is pale and in small quantity at the commencement the vents must be opened. When it is burning well the smoke is quite like steam. It takes from 6 to 8 days to burn a 35-cord kiln. All the openings in the kiln are then carefully closed and luted. After it has stood 2½ to 3 days, 8 to 10 barrels of water are thrown into the top openings, or through the vents, and the next day the charcoal can generally be drawn. It will take five days to cool without watering, and three if water is used. It is necessary before drawing that the fire should be perfectly extinguished. To be certain that the fire is quite out, the charging door or vent-holes are sometimes opened for an hour or two. If there is no increase in the temperature of the air the kiln may be discharged.

The yield of the kilns at Norton's Works is often as high as 60 bushels per cord for hard, and 50 for soft wood. The average is about 50 bushels.

It takes four men and two horses one day to fill the kiln. One man is required in the kiln, and three to draw. Two men can empty it in a day. The coal at Norton's Works is carried from the kiln to a shed only about thirty to forty feet distant, which is forty feet deep having a peaked roof. The building is 275 feet long.

There are thirteen kilns here, and four at twelve miles distant, built of firestone, which hold fifty cords each. It requires eight men for the thirteen kilns. These thirteen kilns can make twenty-two turns a year. Working so fast makes it difficult to burn the charcoal thoroughly, so that they usually run only eighteen kilns a year. It requires thirteen days to fill, burn, and empty a 35-cord kiln. It takes one day to fill, and one to empty it.

In Utah the charcoal is packed in bags, containing two to three bushels, which are hooked up under an opening eighteen inches square in a table three feet high. This table is four feet square on the top.

The charcoal is thrown on to the table and pushed into the bags. Six men will empty a kiln, sack the charcoal, and put it on the cars in one day. The wood is mostly poplar, which is cut dead. The charcoal is very light, and so much was lost by this method that it is now proposed to ship in cars constructed for the purpose without packing. It takes nine to ten days to burn a kiln. At the end of five days all the vents are closed, and they no longer watch it. The fire is extinguished with water; it is not allowed to die entirely. The kilns are whitewashed after every operation. Poplar costs $3 per cord. Pine costs $3.75 per cord. Six men do all the work. The loss in fine coal is very large. The charcoal made from those very soft and often dead woods is very light, so that it crushes by its own weight, and bears transportation very badly. The use of such woods is, however, partially justified by the fact that the coke for the lead furnaces costs in this locality $15 per ton. Thirty-five cords of wood make 1000 to 1200 bushels, of 2680 cubic inches each, of charcoal, or about 45 bushels to the cord. In 1875 the contract was made to deliver at American Fork at 18 cents a bushel.

It seems to be very generally conceded in the Eastern States that the conical kilns holding from 25 to 35 cords are the most profitable. They are less expensive in construction, more easily filled, cheaper to manage, give a better yield, and can be turned more frequently than any of the other varieties of kilns.

STATISTICS OF CONICAL FURNACES.

Charging			Burning.			Cooling.	Discharging.			Per cent of brands.
Time.	Days' work.		Time.	Days' work.		Time.	Time.	Days' work		
Days of 10 hrs.	Men.	Horses.	Days of 24 hrs.	Men.	Horses.	Days of 24 hrs.	Days of 10 hrs.	Men.	Horses	
1	6	1	8	1	0	3	1	4	2	5

Diameter or length, ...	28 feet inside the bottom
Height to spring of arch, ...	$19\frac{1}{2}$ feet
Capacity in cords, ...	35
Number of thousand brick, ...	33
Number of vents, ...	94
Weight of cast-iron vent-holes, ...	14 lbs. each
Pounds of cast iron, ...	3000 lbs.
" of wrought iron	1000 lbs.

Cost per hundred bushels, ...	$ 0 85
Foundation 50 P. of stone, 3 to 4 feet are required, cost,	100 00
Bricks, $5.50 per M., Laying in wall, $4.50 per M., }	820 00
Cast iron for frames, vent-holes, etc., 1 ton, ...	75 00
Total cost of furnace, ...	$495 85

At Plattsburg, in 1879, it cost $7.50, on Lake George $7, and in a few localities in Vermont $6 per thousand bushels to fill, burn, and empty; the average will be from six to seven cents per bushel.

The per cent. of brands in a well-burned kiln will be from one cord in 17.5 cords to one in 18.5.

The charging requires 1 day for 4 men for 35 cords, and 1 day for 5 and 6 men for 50 cords. Two horses are used for the 35-cord kiln at Plattsburg, but the whole work is often done by men with wood barrows.

	50 cords	35 cords.
Days charging, ...	1	1
Men employed charging, ...	5 to 6	4
Horses used, ...	(barrows)	2
Number of days burning, ...	10	6 to 8
Number of men employed burning, ...	1	1
Number of days discharging	1	1
Number of men "	3 to 4	2
Number of horses, ...	2	2
Yield of wood in bushels, ...	50	50
Number of bushels of charcoal to cord of wood,	50	
Weight of bushel,	20 lbs.	{ soft, 11 to 14; hard, 15 to 19

The cost of these kilns will vary with the locality, depending on the local cost of the materials used. It will cost about $500 to build a conical kiln of from 35 to 50 cords in Plattsburg, and about $600 in Michigan, with brick at $17.50 per thousand.

> There seems to be no doubt that the Plattsburg kiln, with iron vent-holes, is the best type of all the kilns. If properly built it lasts a long time without repairs of any kind except an occasional replacing of the clay-tar wash on the outside. At Plattsburg anything in the shape of wood is made into charcoal by it, and while it is not generally advisable to use drift and refuse woods in current manufactures, it can be done if necessary. Such kilns as this can be built by almost any man. They are much easier to take care of than meilers, and in the remote districts, where charcoal is now used as a metallurgical fuel, present every advantage of economy of construction and management, as well as maximum of yield.[11]

In the handbook for charcoal burners a "Bee hive" pattern or form of kiln built in the "Northwest" is described as follows:

> Mr. J. M. White, who has constructed many kilns in the northwest, makes them as follows:—
>
> The foundation is composed of a stone wall 24 inches in thickness and of sufficient height to bring it to the working floor of the kiln, which in most cases, when dry ground has been selected, is a few inches above the level of the ground. Upon this foundation the brickwork is commenced, its shape being given by means of a sweep placed upon a staff so as to revolve easily, thus giving a true circle to the design. This wall is 12 inches in thickness, and contains apertures or vents, three rows of which, placed even distances apart,

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[11] Ibid., pp. 390-397.

encircle the kiln. In constructing, it is the better plan to place the vents so each upper vent on its respective circle shall come between the vents below or in the circle beneath it.

The upper course or circle is usually from three to four feet from the working floor, and the lower immediately upon it, the third circle of vents being equidistant from upper and lower ones. At the elevation of 8 feet the thickness of the wall is reduced to 8 inches, and this thickness continued to the summit or crown. The difference between the 8 and 12 inch walls should be upon the outside, and a single course of brick placed obliquely for the shedding of rain and melting snow. By this means the interior of the kiln has a smooth surface, which should in all cases be closely pointed in its joints and free from any loose material. For the purpose of filling and emptying, two arched doors are built, one upon the floor level and in front, and the other (through which the upper courses of wood are admitted) at an elevation of 12 feet and in the rear. In all cases the wood should be uniformly piled and free from looseness.

In the centre is placed the material with which to put the kiln in operation, access to which is gained by leaving a small space from the centre to the front, through which fire may be introduced, after which this space is filled with wood, and the door closed and cemented to admit of no air while the process of coaling is going on. By means of the vents described above, the fire can be drawn to any portion of the interior desired by the collier, who is always careful to keep them sufficiently open to permit without obstructing the escape of all smoke, etc., which are liberated during the period of charring. When the wood is sufficiently charred, these vents are closed and the fire allowed to die out, usually occupying from three to four days to accomplish it; after which the lower door is taken out and the coal taken from the kiln.

The kiln above described is of the Bee Hive pattern or form, and is made of various capacities, but rarely exceeding 50 nor less than 25 cords.

Mr. White claims that it will yield 38 to 40 bushels of charcoal to the cord of wood employed, and be free from brands. In Berkshire, Massachusetts, with kilns of a capacity of 60 cords each, the product has been 50 bushels to the cord. It is there estimated that the cost of coaling is less than one-half that of coaling in pits when the wood is delivered. At Bennington, Vermont, with kilns of a capacity of 50 cords of wood, the product was 55 to 60 bushels to the cord.

Rectangular piles, holding 30 to 40 cords each, are common upon the shores of the Chesapeake. They are supplied with pine from the forests around the bay.

In the Lake Superior region, both circular and rectangular kilns are common, usually made of brick, but sometimes of stone. In the rectangular kilns the length is from two to three times the breadth.[12]

As can be seen conical kilns seem to vary from the textbook examples according to the materials available and the experience and expertise of the builder. To determine at this time which design variation was superior to the others would be an exhaustive study in itself since it would involve research into the quality and quantity of charcoal produced as well as the economics of each operation. Therefore, we cannot be certain

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[12]Svedelius, op.cit. pp. 184-186.

whether the kilns at Wildrose represent a superior design or just one of many variations of conical types.

Other known conical kilns that can be viewed today in the west represent some of these variations in design and are described here for comparative purposes.

Illustration number 17 photographed 1970 by Warren M. Yenter, Redmond, Washington, shows four stone conical kilns, circa 1900, located on Highway 93 between Challis and Clayton, Idaho.

This design is very similar to the one described above by J. M. White except that it is constructed entirely of stone in lieu of brick and features a unique gothic arched doorway.

Illustration numbers 18 and 19 of kilns near Tybo, Nevada, photographed August 1969 by John A. Blume & Associates, San Francisco, Ca., for The Nevada Operations Office, Atomic Energy Commission, are similar to the kilns in Idaho being constructed of stone.

The doorway is traditionally textbook and the kilns have an opening at the apex which is similar to the eastern brick ovens.

Near the kilns at Tybo, Nevada, are other groupings of kilns, illustration numbers 20 and 21, photographed by John A. Blume & Associates, San Francisco, Ca., for the Nevada Operations Office, Atomic Energy Commission, and identified as "4 Mile Kilns" and "6 Mile Kilns."

These kilns are close to the textbook examples only in that they are constructed of brick and the doorways represent two types of traditional design. They vary from typical design in the heavy stone veneer which would seem to aggravate the venting operation. Also the extreme ratio of height to width vary greatly from recommended practice and would seem awkward to charge and unload.

The kilns at Wildrose, photographs 9 to 16, vary from the norm in that they are built entirely from stone, with the exception of Kilns numbers 3 and 4 that have brick lintels at the upper doors only.

Their size ratio is normal to recommended practice. One feature is the waterproofing on the outside where the other examples were not. The inside surface plaster follows the eastern practice. The doors however were not set against a metal or masonry frame as the other noted examples indicate. There is no evidence available to date if the noted kilns had brick floors or if the builders followed local conditions and used hard packed clay or well tamped gravel and coal dust.

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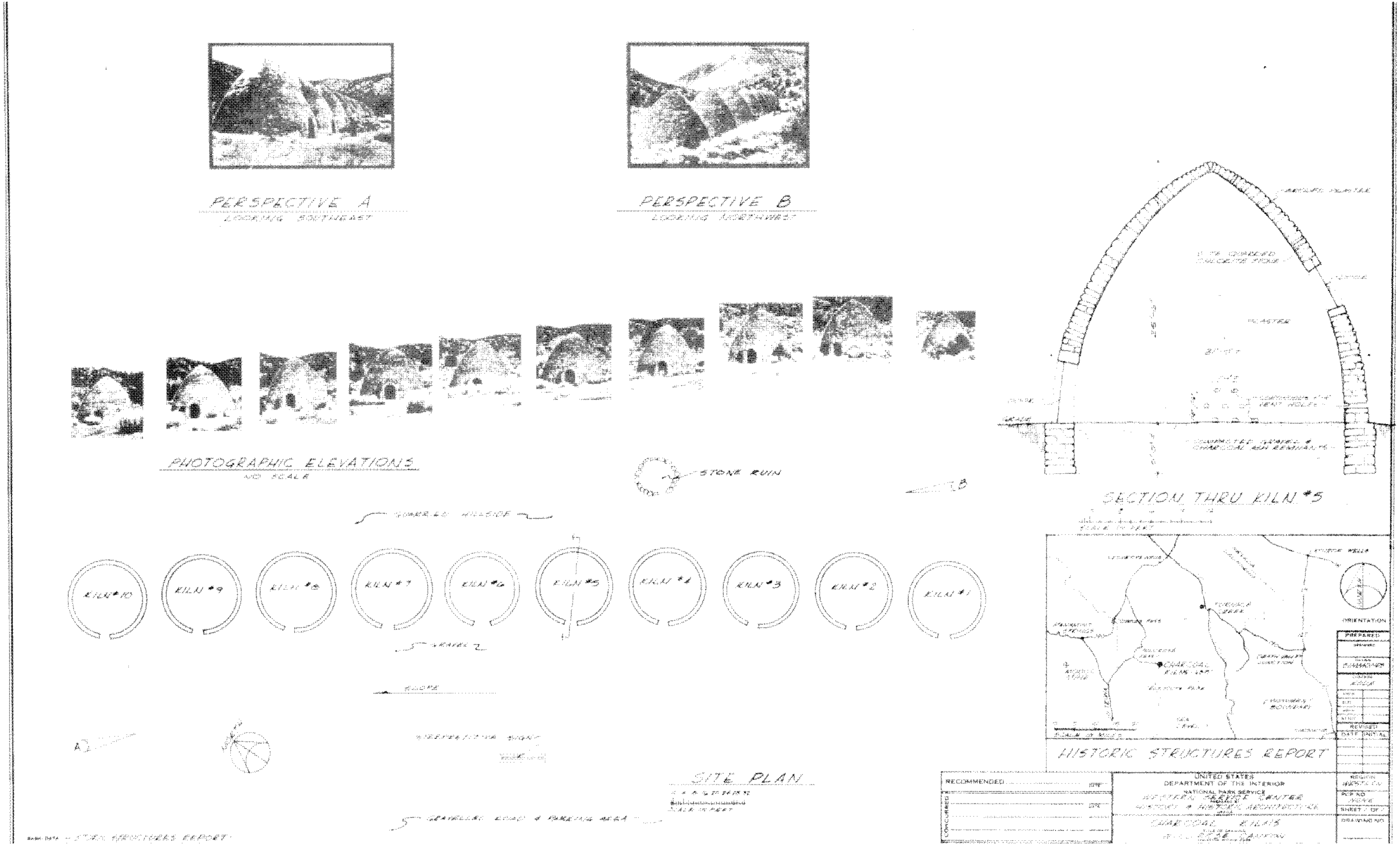
ILLUSTRATIONS


PERSPECTIVE A
LOOKING SOUTHEAST
PERSPECTIVE B
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STONE RUIN
SECTION THRU KILN #5
SCALE IN FEET
PLASTER
GRADE
KILN #10
KILN #9
KILN #8
KILN #7
KILN #6
KILN #5
KILN #4
KILN #3
KILN #2
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UNITED STATES
DEPARTMENT OF THE INTERIOR
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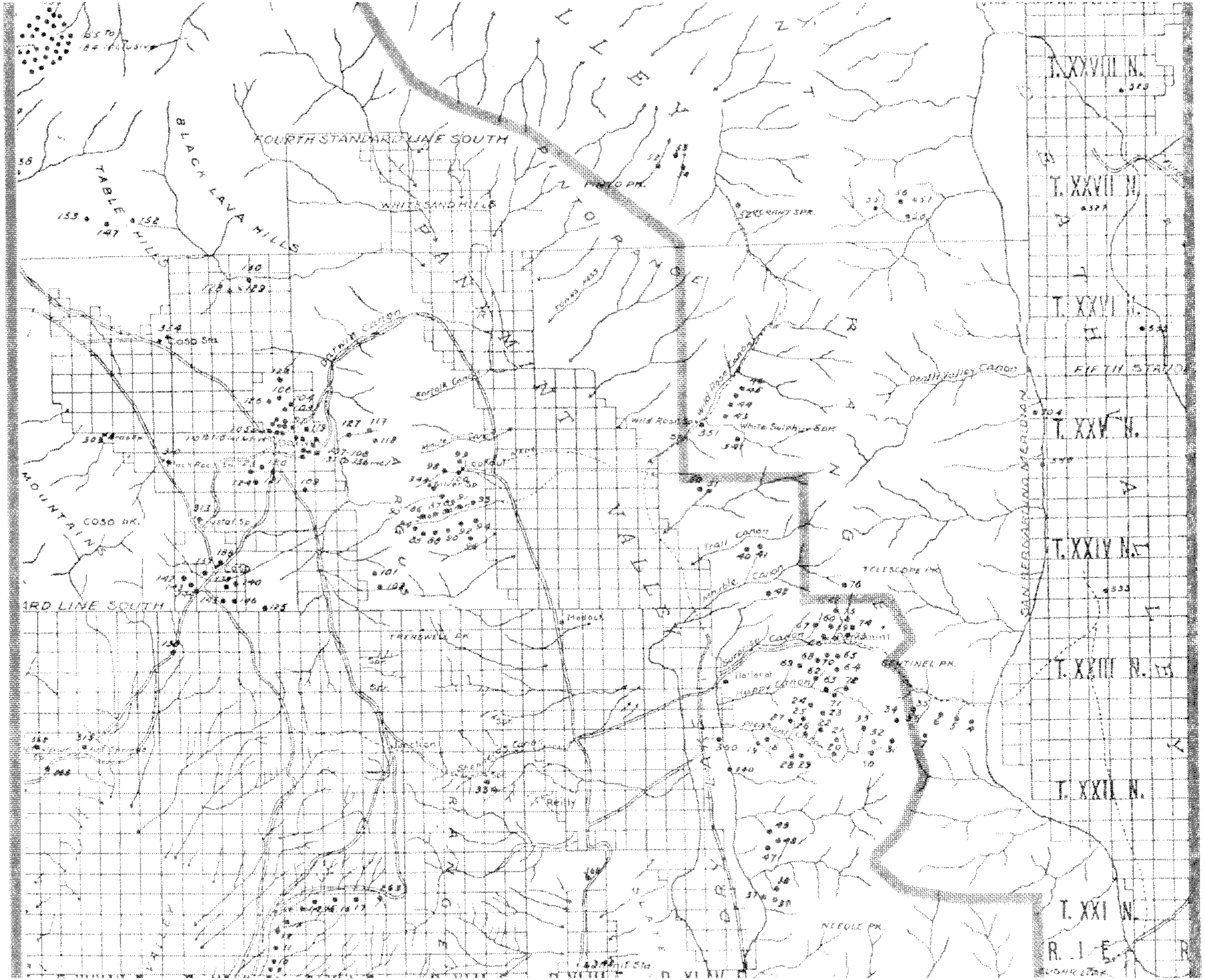
CHARCOAL KILNS
REGION
SHEET OF
DRAWING NO



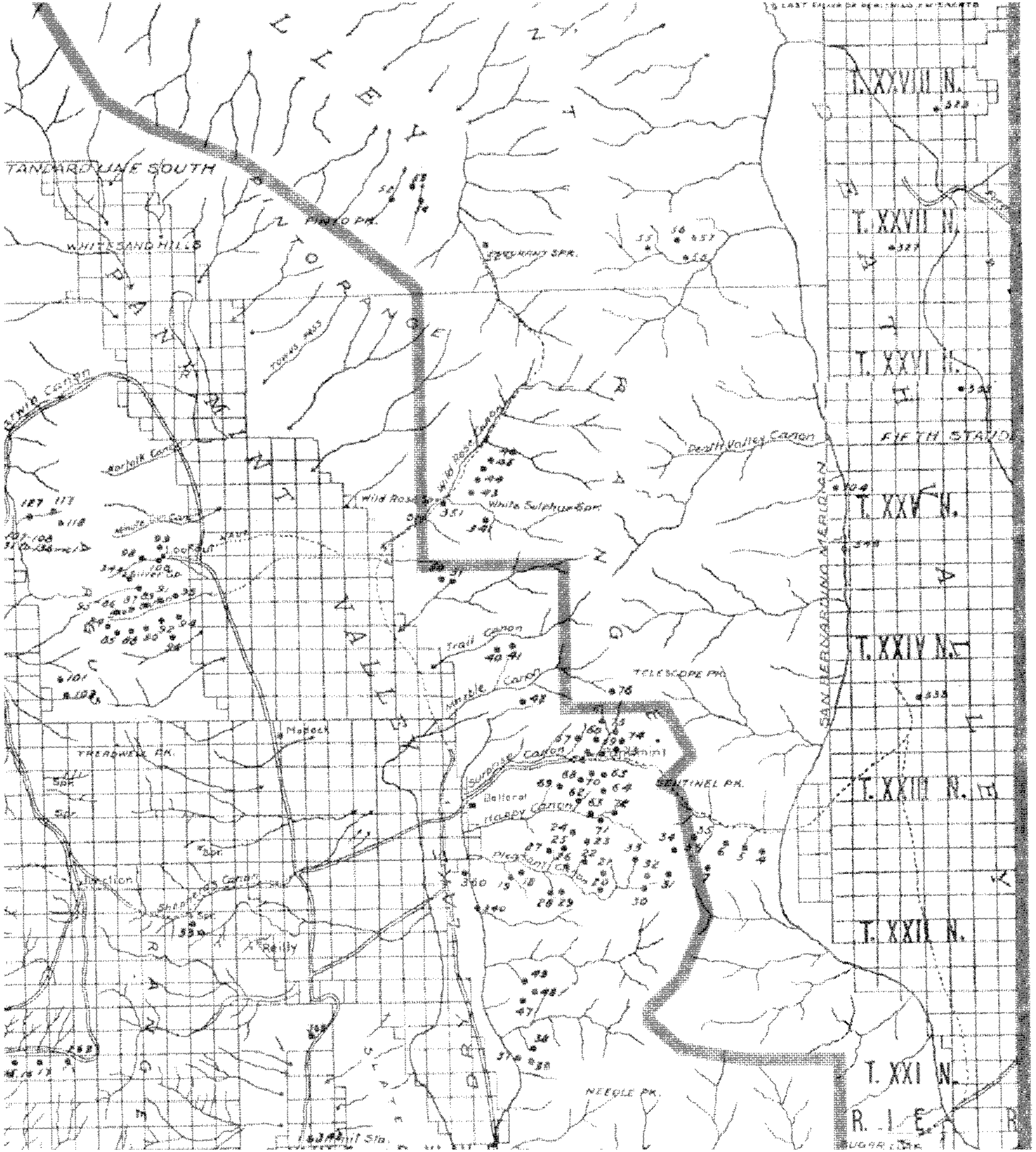
MAP OF INYO COUNT

(Death Valley/Pana

4 Black Bear
5 Bodie
6 Durango
7 Golden Treasure
18 Post Office
22 John Davis
23 Star
24 Elephant
25 Comstock
26 Gen. E. Lee
27 Mammoth
29 Ratcliff
30 New Century
31 Alta
32 Customer
33 Centurion
34 St. Patrick
34 *St. Patrick
35 Cooper
37 Bunko
38 Kings Consolidated
No. 1
39 Kings Consolidated
No. 2
40 Gold Note
41 Big Bill
42 Hill Top
*43 Monarch
44 *Combination
45 *Monopoly
45 Monopoly
*46 Kennedy
46 Kennedy
47 Mineral Hill
48 Mineral Ranch
50 *Tuber (X)
51 Tuber
52 Lafayette
53 Washington
54 Bullion
55 Garibaldi
56 Silver Star
57 Dane
58 Kennedy

60 Cong
61 Curr
62 Umpi
63 Maro
64 Wyom
65 Heal
66 Stew
67 Eure
67 Jaco
68 Alab
70 Litt
71 Coms
72 Star
73 Inde
74 Chal
75 Ida
76 Hude
80 Red
86 Blue
87 Stan
88 Buff
89 Owl
91 Merr
92 Blue
93 Sayr
94 Jump
97 Cust
98 St.
99 Modo
101 Gold
102 Last
103 Luck
104 Chri
105 Phoe
106 Bran
107 Lane
109 Colu
110 Defi
111 Driv
112 Bern
113 Inde
114 Esse
115 Esse
117 Carr

All Darwin except *Ballarat
Mineral Springs [X]
Mills (X)



MAP OF INYO COUNTY, CALIFORNIA (1902)

(Death Valley/Panamint Valley Section)

4 Black Bear
5 Bodie
6 Durango
7 Golden Treasure
18 Post Office
22 John Davis
23 Star
24 Elephant
25 Comstock
26 Gen. E. Lee
27 Mammoth
29 Ratcliff
30 New Century
31 Alta
32 Customer
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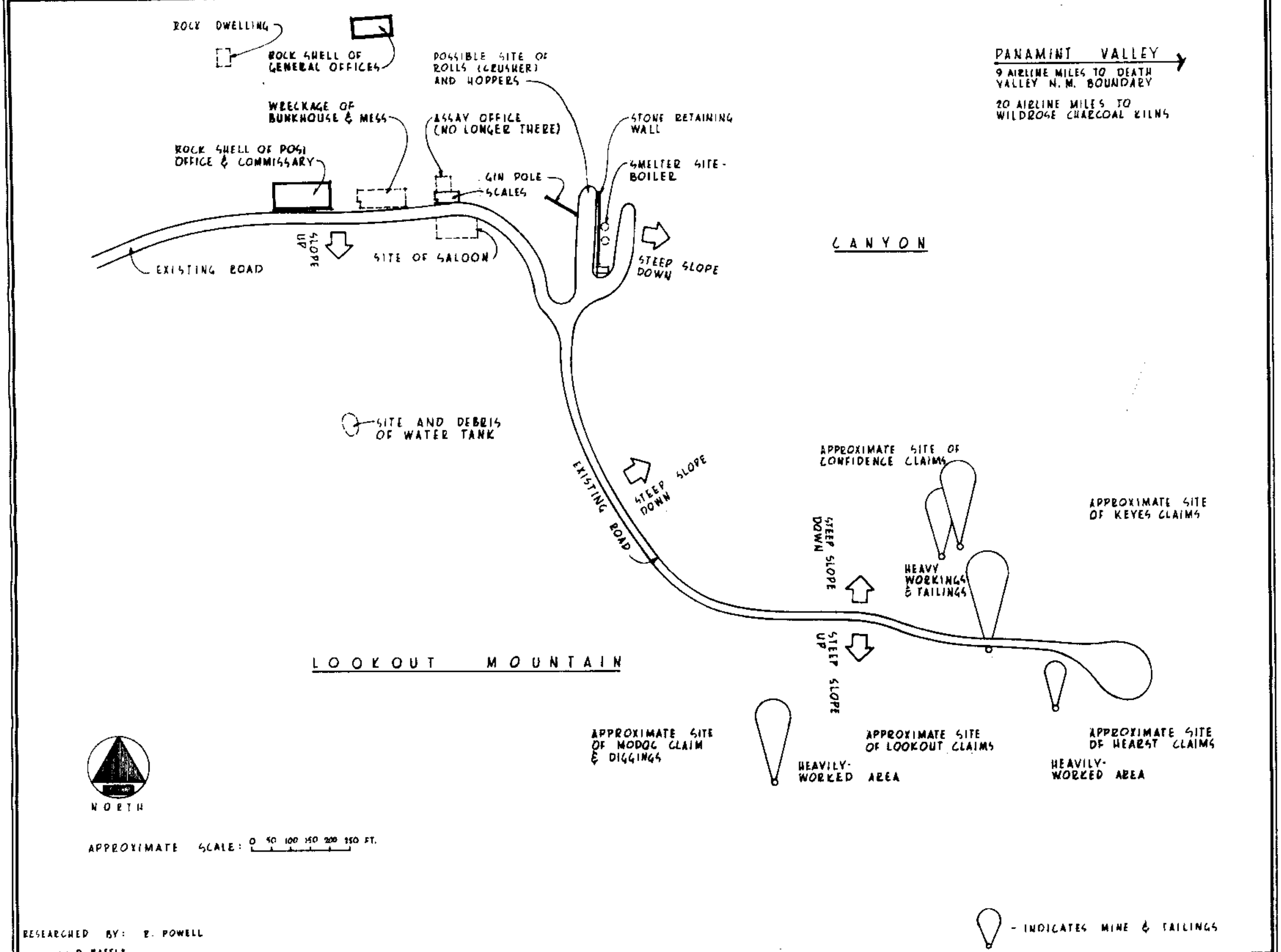
45 Monopoly
*46 Kennedy
46 Kennedy
47 Mineral Hill
48 Mineral Ranch
50 *Tuber (X)
51 Tuber
52 Lafayette
53 Washington
54 Bullion
55 Garibaldi
56 Silver Star
57 Dane
58 Kennedy
60 Congress
61 Curran
62 Umpire
63 Narogansett
64 Wyoming
65 Hemlock
66 Stewards Wonder
67 Eureka
67 Jacobs Wonder
68 Alaban
70 Little Chief
71 Comstock
72 Star
73 Independence
74 Challenge
75 Ida
76 Hudson River
80 Red Rock
86 Blue Belle
87 Standard
88 Buffalo
89 Owl
91 Merry Christmas
92 Blue Bird
93 Skyrocket
94 Jumper
97 Custer
98 St. John
99 Modock
101 Gold Ridge
102 Last Chance
103 Lucky Jim
104 Christmas Gift
105 Phoenix
106 Branch Mint
107 Lane & Last Chance
109 Columbia
110 Defiance
111 Driver
112 Bermon
113 Independence
114 Essex #1
115 Essex #2
117 Carribo
118 Kearsage
119 Brittania
120 Lucky Bill
121 Carbonate
122 Olive Branch No. 2
123 Roosevelt
124 Silver Band
125 St. Andrew
126 Rex
127 Rosetta
128 Empire
129 St. Louis
130 Pittsburgh
131 Monterey
132 Kingman
133 Hold Out
134 Richardson
135 Jackass
136 Mayday
137 Good Thing
138 Ninety-eight
139 Mammoth
140 Ethel
142 San Lomardo
143 San Leon
144 Josephine
145 Ninety-eight
146 Mariposa
171 Modock
241 Worldbeater
303 Arab /X/
304 Bennett Wells
310 Black Rock /X/
313 Crystal /X/
315 Coso Hot /X/
324 Franklin Wells
325 Fresh
326 Furnace
327 Greenald
333 Moquito
339 Salt
348 Tule
351 Wild Rose /X/
354 Water Station /X/

All Darwin except *Ballarat
Mineral Springs /X/
Mills (X)

"MADE" is a map maker's error referring to the Madeau Trail



RESEARCHED BY: R. POWELL

DRAWN BY: D. BATTLE

UNDER DIRECTION OF THE NATIONAL PARK SERVICE, UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE

MODOC MINING AREA & LOOKOUT TOWNSITE ON LOOKOUT MTN. INYO CO. CALIFORNIA

1970

SURVEY NO.

SHEET 1 OF 1 SHEETS

Illustration No. 4 Kilns prior to CCC stabilization, view looking up Wildrose Canyon. Photograph taken by George Grant, December 2, 1935; DVNM #3160.

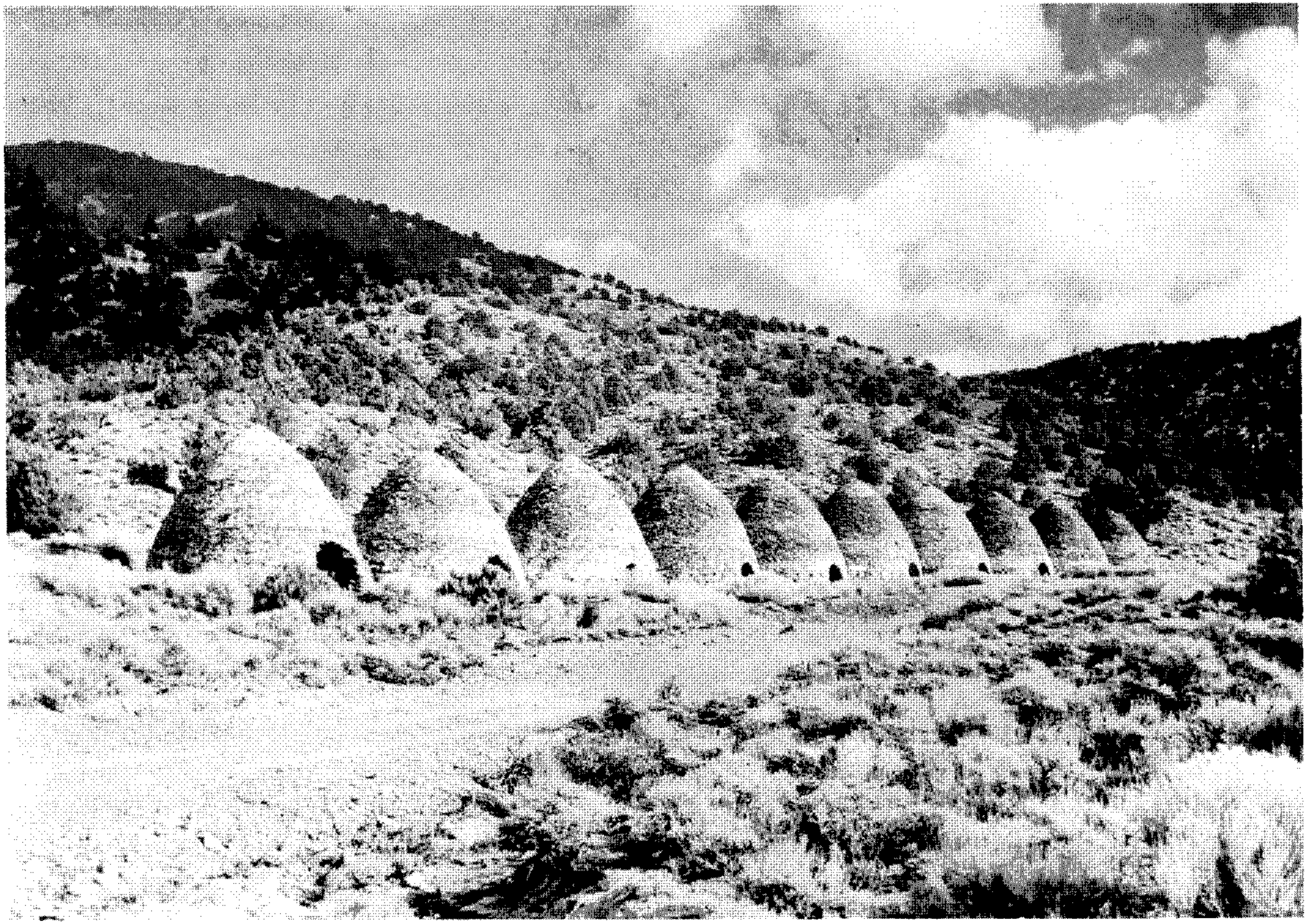


ILLUSTRATION 4

Illustration No. 5, View looking down Wildrose Canyon
Photograph taken by George Grant, December 2, 1935

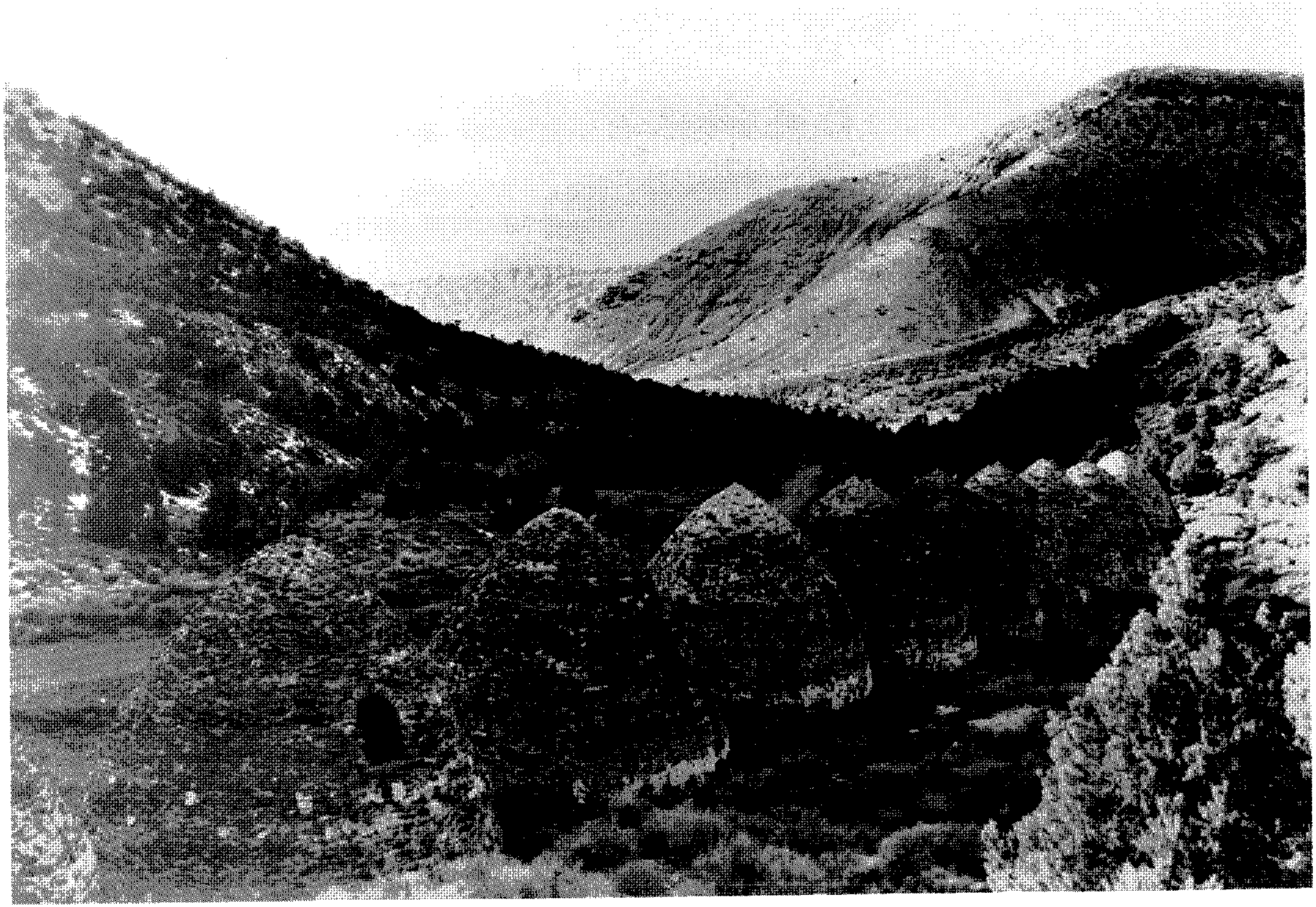


ILLUSTRATION 5

Illustration No. 6, Ruins of old Modoc company town on Lookout Mountain - 1970. Photograph taken by Richard Powell, Park Ranger, Death Valley National Monument.

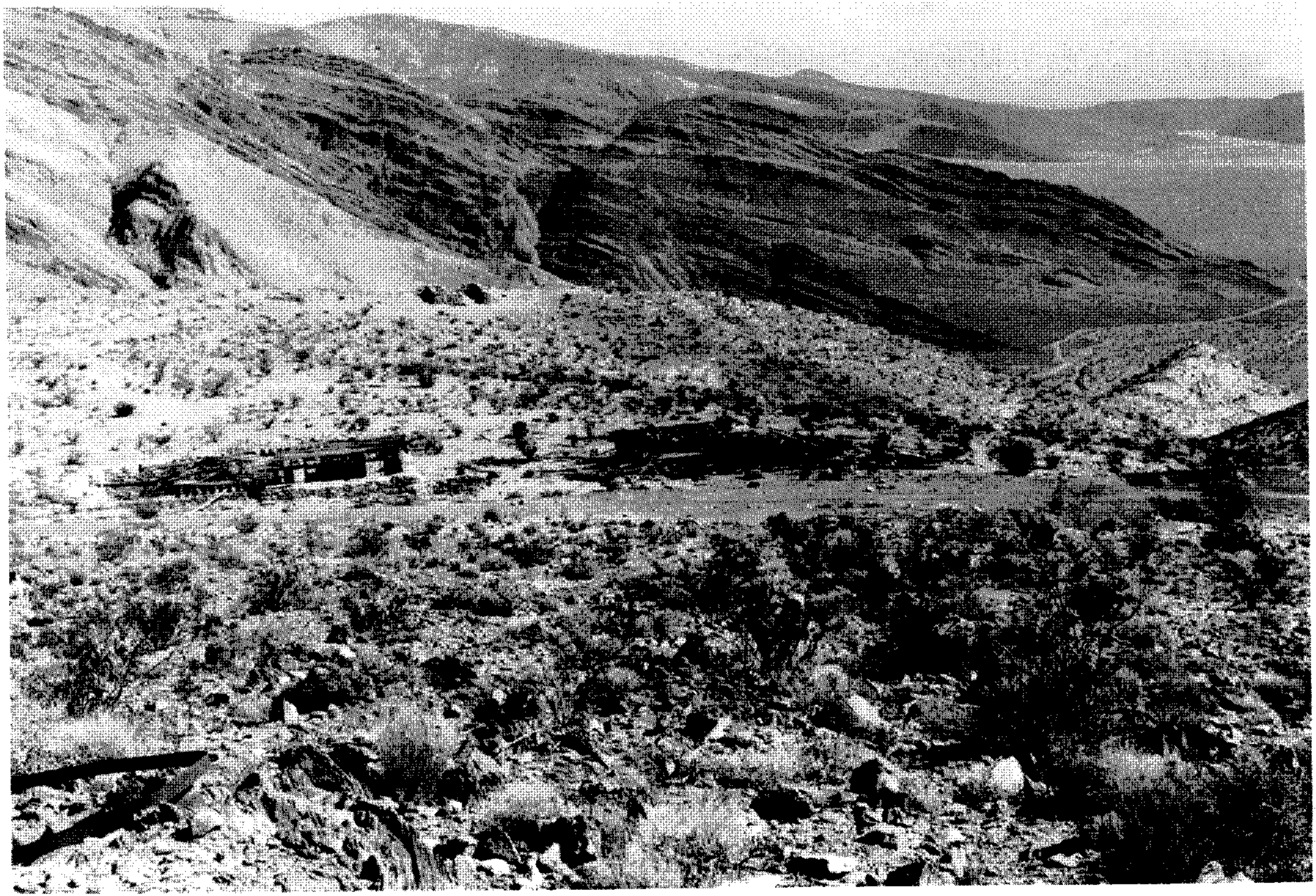


ILLUSTRATION 6

Illustration No. 7, Mining community of Darwin. The 1970 setting is unchanged, but extent of authentic remains from 1880 period is unknown. Photograph taken by Richard Powell, Park Ranger, Death Valley National Monument.

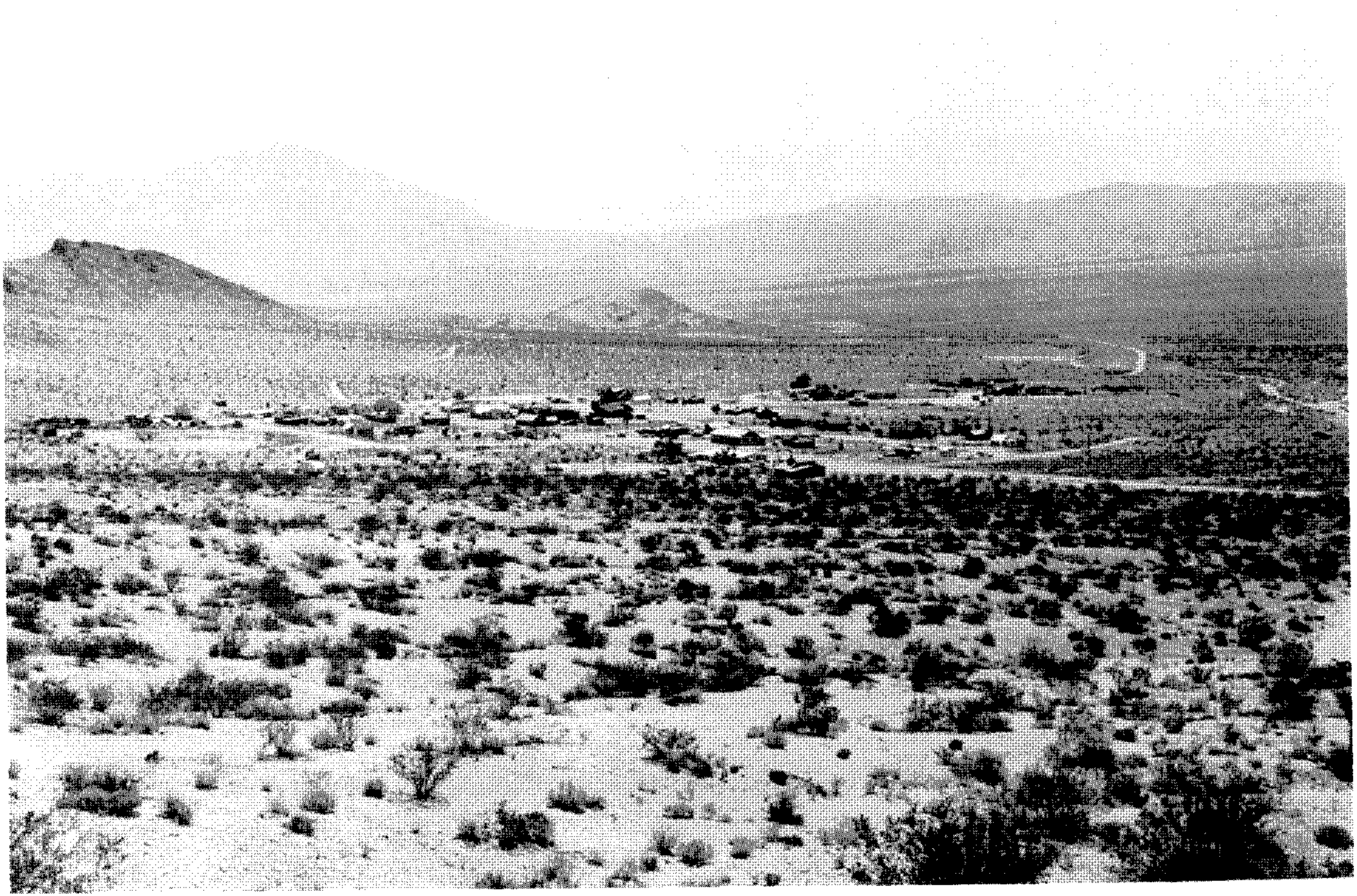


ILLUSTRATION 7

Illustration No. 8, Abandoned Modoc mine complex on Lookout Mountain. The conspicuous road and turnaround is presumably of late period. Photograph taken by Richard Powell, Park Ranger, Death Valley National Monument, 1970.

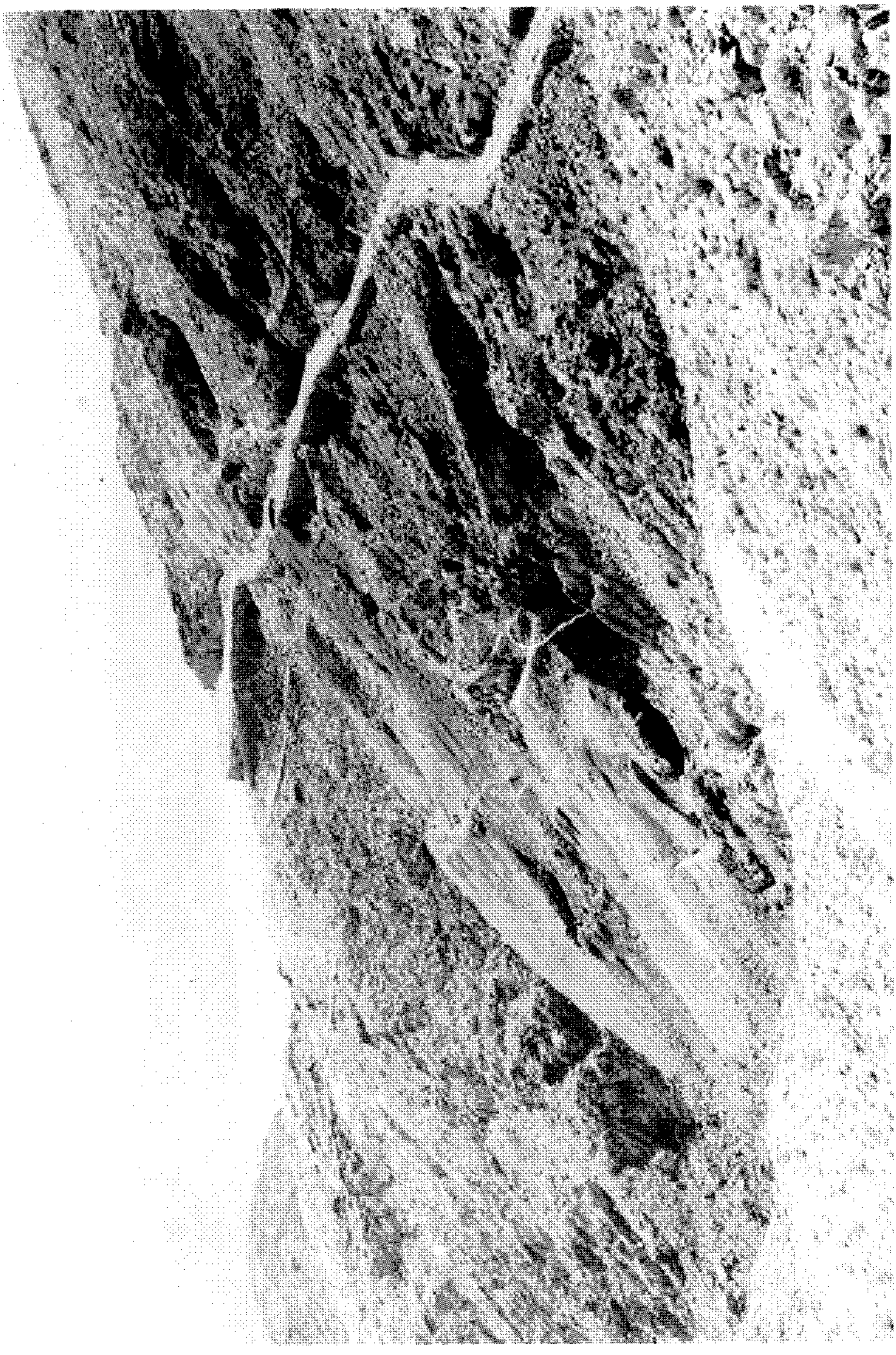


Illustration No. 9, Looking northeast from Lookout Mountain across site of old Modoc smelter toward Panamint Valley. Photograph taken by Richard Powell, Park Ranger, Death Valley National Monument, 1970.

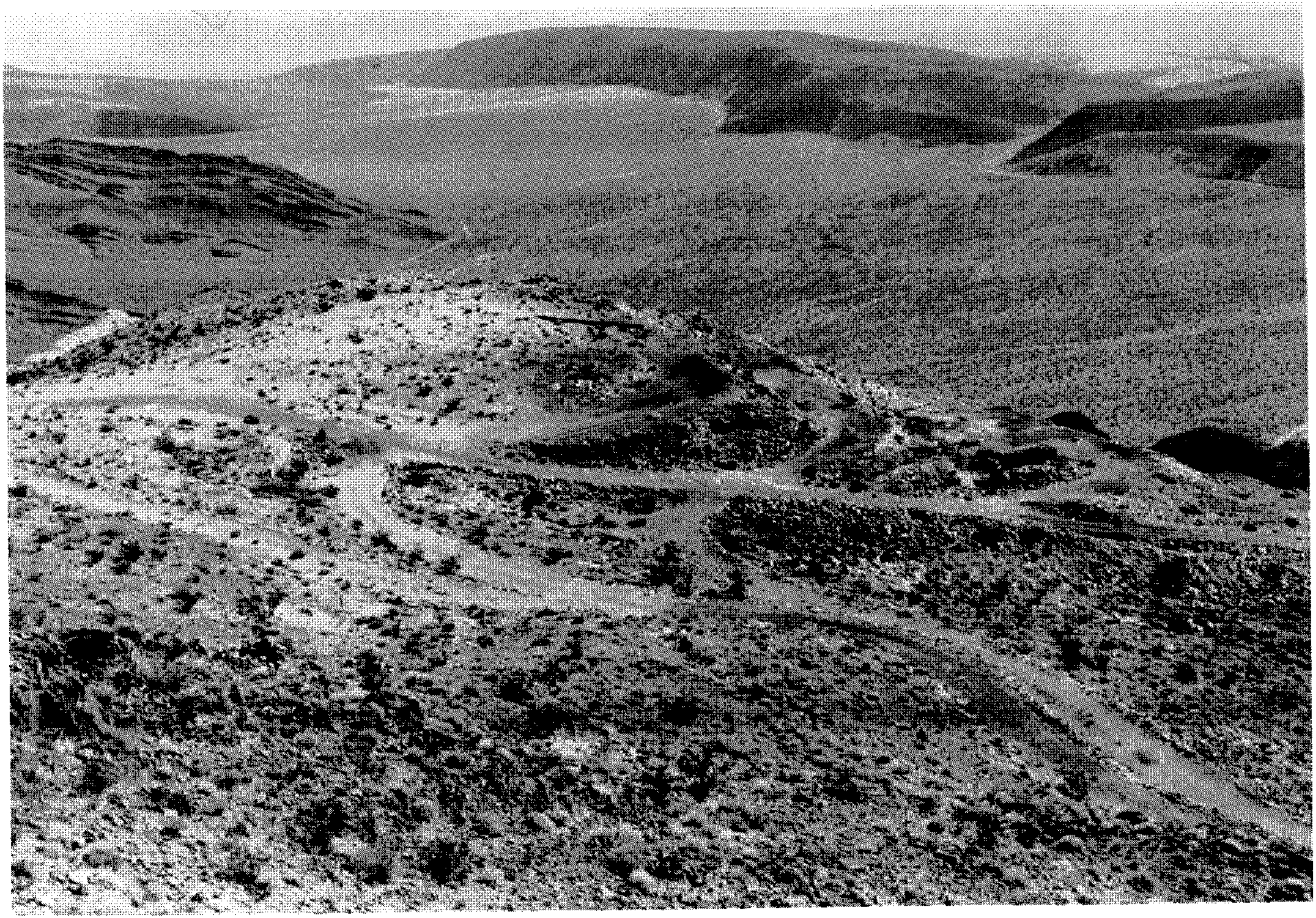


ILLUSTRATION 9

Illustration No. 10, Remains of Modoc smelter where Wildrose charcoal was used. Photograph taken by Richard Powell, Park Ranger, Death Valley National Monument, 1970.

ILLUSTRATION 10

Illustration No. 11, Remains of water tank at Lookout. Photograph taken by Richard Powell, Park Ranger, Death Valley National Monument, 1970.

ILLUSTRATION 11

Illustration No. 12. Front view of Kilns looking up Wildrose Canyon. Photograph taken by Robert V. Simmonds, February 1970.

ILLUSTRATION 12

Illustration No. 13. Rear view of Kilns looking up Wildrose Canyon. (Note new growth of Pinyon Pine Forest in the upper reaches of the Canyon.) Photograph taken by Robert V. Simmonds, February 1970.

ILLUSTRATION 13

Illustration No. 14. North side of Kilns showing the Quarried area of the hillside to obtain stone for the Kiln construction. Photograph taken by Robert V. Simmonds, February 1970.

ILLUSTRATION 14

Illustration No. 15. Rear view of Kilns nos. 5 - 10 looking west and location of stone ruin foreground. Photograph taken by Robert V. Simmonds, February 1970.

ILLUSTRATION 26

Illustration No. 16. Detail view of rear vent opening.
Photograph taken by Robert V. Simmonds, February 1970.

ILLUSTRATION 16

Illustration No. 17. Detail of rear door outside surface. Photograph taken by Robert V. Simmonds, February 1970.

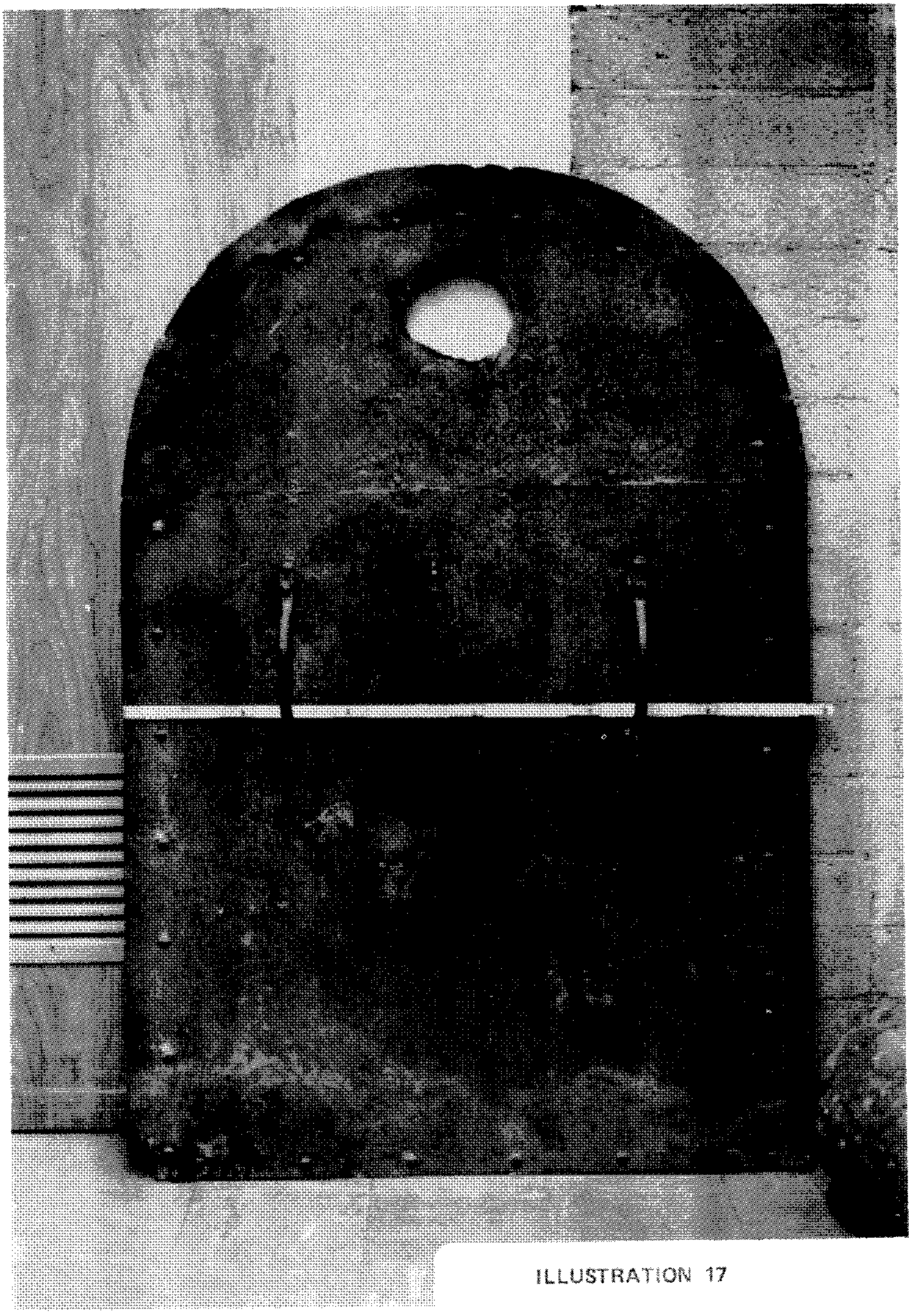


ILLUSTRATION 17

Illustration No. 18. Entrance door opening. (Note the change from common horizontal coursing at the halfway point or above the vent level to stone laid normal to the tangent of the curve of the Kiln surface.) Photograph taken by Robert V. Simmonds, February 1970.

ILLUSTRATION 18

Illustration No. 19. View of typical vents and eroding mortar finish. Photograph taken by Robert V. Simmonds, February 1970.

ILLUSTRATION 19

Illustration No. 20. Charcoal Kilns, Circa 1900, located between Challis and Clayton, Idaho on Highway 93. Photograph taken by Warren M. Yenter Redmond, Washington, May 6, 1970.

ILLUSTRATION 20

Illustration No. 21, Tybo Kilns, view from rear, located in Nevada. Photograph taken by John A. Blume & Associates, San Francisco, Cal., August 1969, for the Nevada Operations Office, Atomic Energy Commission.

ILLUSTRATION 21

Illustration No. 22, Tybo Kilns, interior top, located in Nevada. Photograph taken by John A. Blume & Associates, San Francisco, Cal., August 1969, for the Nevada Operations Office, Atomic Energy Commission.

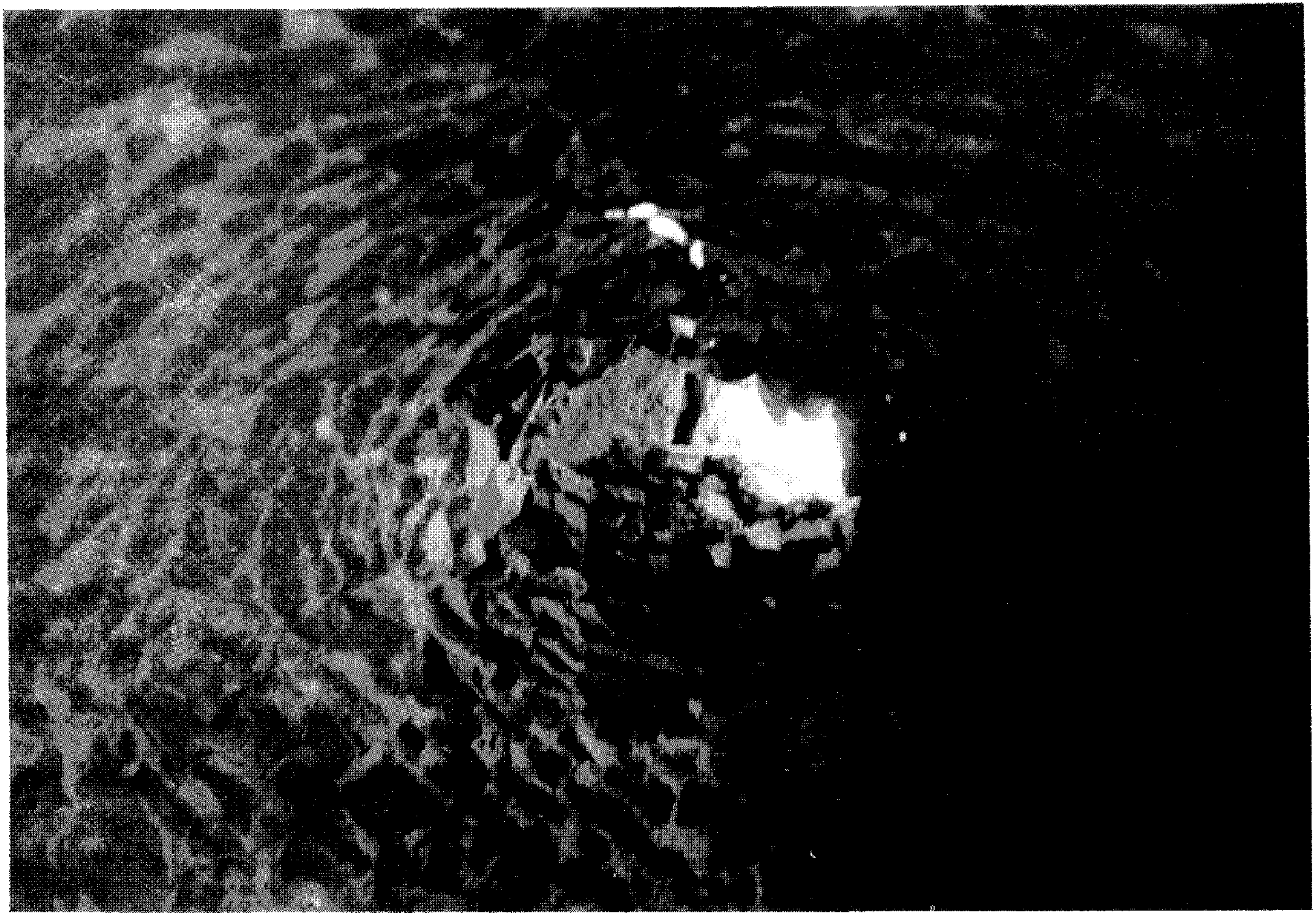


ILLUSTRATION 22

Illustration No. 23. 4 Mile Kilns, interior, rear opening, located in Nevada. Photograph taken by John A. Blume & Assoc., San Francisco, Cal., August 1969, for the Nevada Operations Office Atomic Energy Commission.

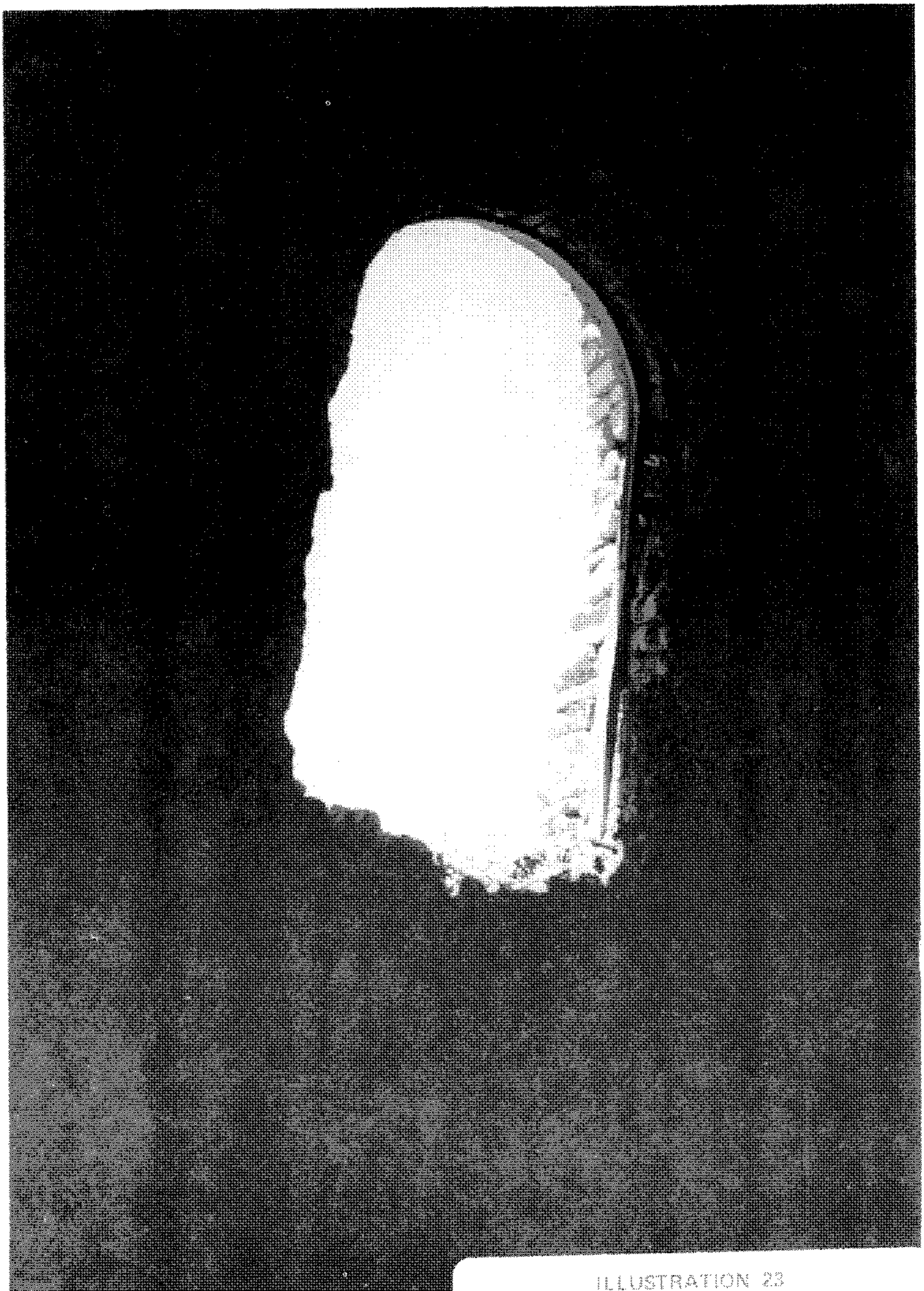


ILLUSTRATION 23

Illustration No. 24, 6 Mile Kilns, Site 2, view from front, located in Nevada. Photograph taken by John A. Blume & Associates, San Francisco, Cal., August 1969, for the Nevada Operations Office, Atomic Energy Commission.