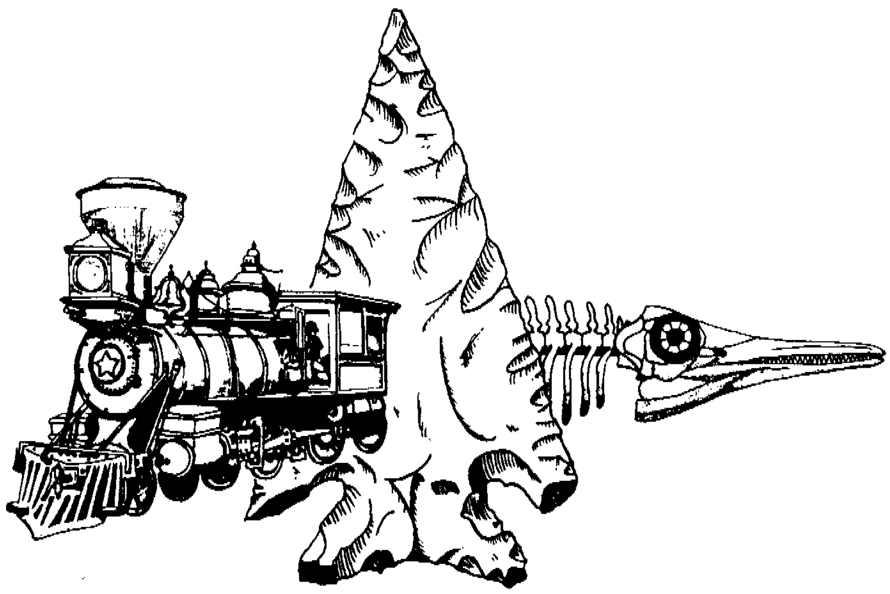
BUREAU OF LAND MANAGEMENT
NEVADA

CONTRIBUTIONS TO THE STUDY OF CULTURAL RESOURCES



ARCHAEOLOGICAL STUDIES IN THE CORTEZ MINING DISTRICT, 1981
TECHNICAL REPORT NO. 8

THE HISTORY AND ARCHAEOLOGY OF FENELON, A HISTORIC RAILROAD CAMP
TECHNICAL REPORT NO. 9

RENO, NEVADA 1982

FORWARD

The two reports offered in this volume provide further information on historic sites in rural northern Nevada, and are part of a continuing effort by the Nevada BLM to disseminate information resulting from contract cultural resource work on public lands in Nevada. "Archaeological Studies in the Cortez Mining District, 1981" by Donald L. Hardesty, University of Nevada-Reno, and Eugene M. Hattori, Desert Research Institute, Reno, is a report on the first year's results of a multi-year research project jointly sponsored by the Bureau of Land Management and the University of Nevada-Reno. Further excavations and survey efforts were conducted in the summer of 1982 and the project is scheduled to continue through the following years. The present report sets the basis for the later field seasons by not only describing the field discoveries of 1981, but also presenting information gathered through initial archival searches.

"The History and Archaeology of Fenelon: A Historic Railroad Camp" by Arnie L. Turner, Intermountain Research, Silver City, Nevada, is a unique document in presenting an indepth study of a small historical railroad camp. The project was funded by Sun Oil, Denver, Colorado. Though Fenelon was not found to be of outstanding significance in itself, the study provides an excellent example of investigating the historical and archaeological records of a small, rural development and is included here primarily for that reason.

Both reports offer new information on facets of Nevada history of which little has been written to-date.

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November, 1982

ARCHAEOLOGICAL STUDIES

in the

CORTEZ MINING DISTRICT

1981

by

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Report Submitted to the
Bureau of Land Management
Battle Mountain District

Contract Number NVO-60-CT1-1

September 1982

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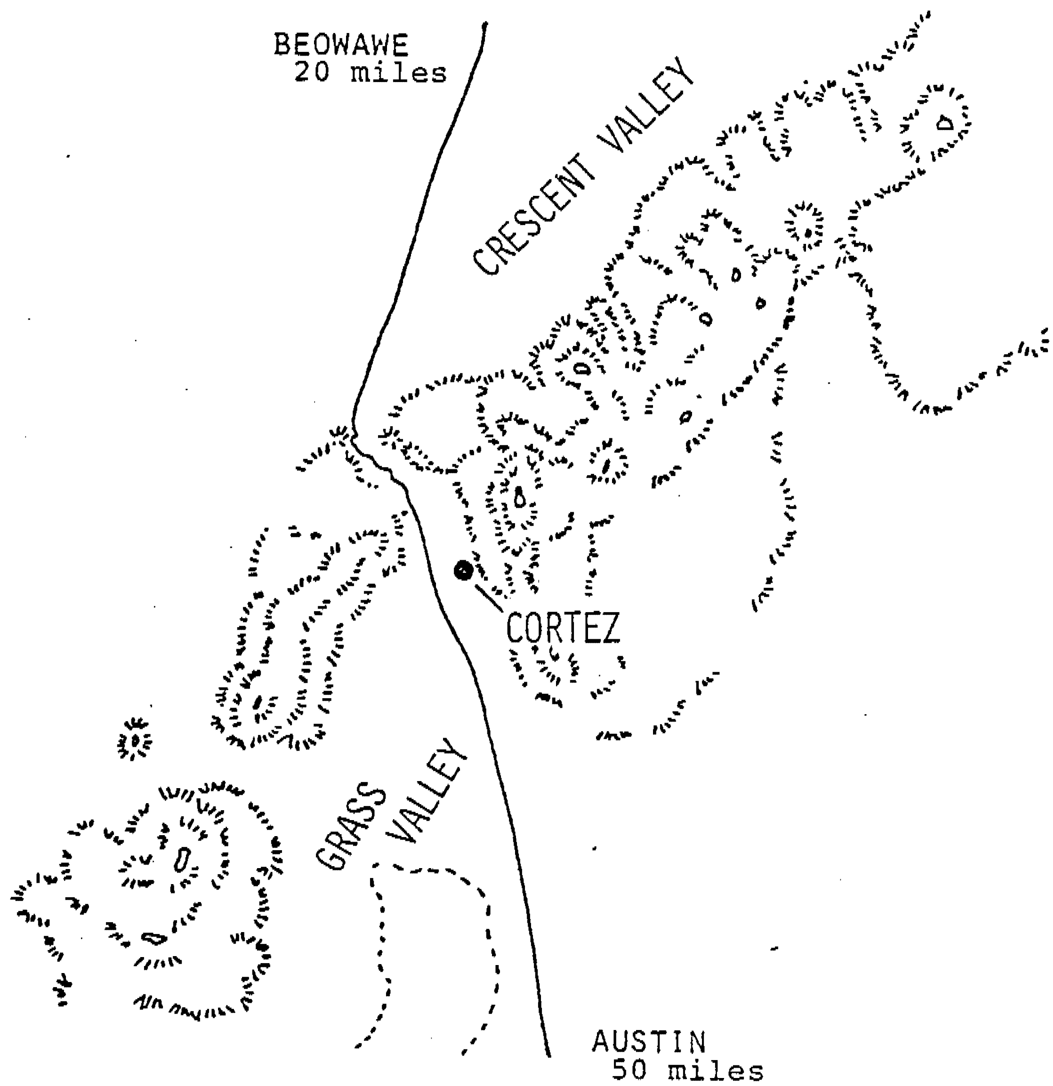


FIGURE 1. LOCATION OF CORTEZ DISTRICT

INTRODUCTION

The Cortez Mining District in the Cortez Mountains of central Nevada(Figure 1) was established in 1863 and continues to be mined today. Never a large producer by Comstock District standards, Cortez is unusual, nevertheless, for its continuity. Archaeologically, the district is also unusual for the relatively good preservation of its mines, mills, and settlements and for its rather long record of mining activities. Both vandalism and current mining are, however, accelerating the rate at which cultural resources in the district are being destroyed. The site of "Old" or "Lower" Cortez is especially threatened because of its visibility - it is alongside the main road through Grass Valley and includes easily seen stone and adobe foundations, many of which are associated with "pretty" Chinese artifacts. For that reason, the Bureau of Land Management contracted with the University of Nevada, Reno, in 1981 to begin an archaeological study of the district. Donald L. Hardesty is the Principal Investigator. The Scope of Work stipulated that the study is to include design and implementation of a mapping, excavation, and evaluation strategy for Old Cortez and a site survey strategy for the entire district. In this progress report, current development of a "management strategy" for the district is described, along with results of the 1981 survey and excavations at Old Cortez - now recognized as the settlement of Shoshone Wells.

Accomplishment of the 1981 phase of the Cortez Project would not have been possible without the assistance of a number of people. The UNR field school members, who contributed the labor, were Mary Panelli, Ben Barnette, Sherri Campbell, Margaret Herleman, Ralph McAllister, Peggy Waski, Gretchen Holbert, Lynne Horton, Maureen Pisani, and Jonell Koutac. Laurel Crittenden served as graduate field assistant. Alvin McLane did much of the archival research, and for that we are most grateful. We would also like to acknowledge the help of the BLM district archaeologist Roberta McGonagle and state archaeologist Richard Hanes with administrative details. Finally, thanks go to Mollie Flagg Knudtsen for her invaluable information and interest in the project and to Tony Lesperance for assisting with the logistics of living at the Gund Ranch.

MANAGEMENT STRATEGY

The management strategy proposed for the Cortez Mining District is similar to that used in the Resource Protection Planning Process(RP3) of the U.S. Department of the Interior(Division of State Plans and Grants 1980) and applied in various forms by the Massachusetts Historical Commission(1979), the Danville(Virginia) and the Comstock(Nevada) Rehab team projects of the National Architectural and Engineering Record(1980), and the archaeological element of the Nevada Historic Preservation Plan(1982). Components of the strategy are organization of existing data for the district; definition of "study units" with distinctive cultural, chronological and/or geographical boundaries; identification and evaluation of data within each study unit and formulation of appropriate plans for protecting resources within each study unit; and integration of protection plans for all study units into an overall management plan for the district.

Phase I of the Cortez project was mostly devoted to the first two stages. An archival search for appropriate manuscript, photographic, cadastral, and other historical materials was conducted, along with a complementary search of archaeological site record files. From information gleaned from these activities came a general sketch of the history of human activities in the district. The historical sketch was then used to define a set of study units with mostly chronological boundaries. Such units have, apparently, distinctive patterns of human behavior and are, therefore, expected to have somewhat different kinds and locations of archaeological and historical resources. The study units include, in chronological order: prehistoric foraging period, mining exploration period, Wenban's Mill period, the Consolidated Cortez period, and the Post-Consolidated Cortez period.

After the definition of study units in the Cortez district, the phase I project developed site location models to assist in data identification. Site location modelling is derived from a study of land use patterns for each of the study units. On the Comstock distinctive land use patterns were found to be associated with foraging, mining, milling, and urbanism(Hardesty and Firby 1980); the way in which these activities or social relationships were patterned over time led to a distinctive model of land use for each chronological period defined in that study. The same approach is used for the Cortez project. In the Cortez district, land use patterns appear to have demographic, technological, social, and ecological components - each of which can be modelled separately for analytical purposes. The demographic component of land use in the district reflects population growth and decline, geographical distribution, and age/sex composition. Rates of in-migration and out-migration; sex ratios; and the geographic distribution, numbers, and composition of households are especially important. Social impacts upon land use patterns in the district are mostly related to ethnicity and ethnic relations, industrialization and "Victorianism." Archaeologically, the social component is reflected in visibility of ethnic settlements or neighborhoods, geographical relationships of worker's settlements to mining and milling sites and "management," and material manifestations of Victorian culture. Technological processes also have an impact upon Cortez land use patterns. The shift from pan amalgamation milling to lixiviation, for example, demanded not only introduction of new machinery with a new spatial and functional organization but also local mining of new materials such as sulfur and lime for use in the milling process. Finally, the ecological component of land use refers to the relationship between human activities and Cortez ecosystem within which the human populations participated. Patterns of deforestation, ground water mining, impact of cyanidated tailings upon soils and plants - all of these are relevant here.

Modelling land use patterns for each of the study units was then followed by development of a single model of land use zones for the district. The land use zone model is created by overlapping models of land use patterns for all of the study units and identifying those geographical areas of the district that are expected to have distinctive archaeological sites. In the Comstock district, for example, land use zones were found to be ultimately structured by hydrology, location of ore bodies, the location of "gravity centers" such as towns and transportation corridors, locations of quarries, and locations of petroglyphs(Hardesty, Firby, and Siegler 1982). The preliminary model of land use zones for the Cortez district is structured by many of the same things. Such a model is intended as a management tool for rapid identification of site types and site locations throughout the district.

After the data identification stage, the phase I Cortez project turned to data evaluation for each of the study units and then to the district as a whole. The research strategy, to be discussed shortly, is directly tied to this step in the management strategy; much of the "significance" attributed to archaeological sites in the district emerges from research problems and methods proposed for their solution. In these terms the evaluation of site significance is chiefly predicated upon what contribution the archaeological record can potentially make to: (1) understanding of land use patterns in each study unit; and (2) understanding of the processes that change land use patterns. Methodologically, therefore, evaluation of site significance consists of formulating alternative models of land use patterns and their transformation over time and devising competing hypotheses and test implications that will allow assessing relative correctness of the alternatives. Sites that contain information permitting that kind of assessment are given higher significance ratings than those that do not. For the Cortez mining district the key explanations are centered upon theories of frontiers and boundaries, evolutionary theories of change, and industrialization. The end-product of the data evaluation stage of the management strategy is creation of a preliminary model of significance zones . Each significance zone is, in effect, a land-use zone to which a significance rating has been assigned, thereby combining the data identification and data evaluation stages of all study units in the district. The final stage of the management strategy for the Cortez project is formulation of plans to protect cultural resources in each of the significance zones in the district, including establishment of a set of protection priorities. From such a protection plan can evolve a general management plan for cultural resources by taking into consideration the economic, political, and social context of the district.

THE PREHISTORIC FORAGERS STUDY UNIT

The earliest archaeological evidence of human occupation of the Cortez mining district is expected to be associated with Native American populations before the beginning of the historic period. How much before is unknown. Prior archaeological work on this period in the southern part of Grass Valley, however, has yielded large projectile points suggestive of the interval between the end of the Pleistocene and about 5,000 years ago(Clewlow and Pastron 1972). Similar evidence was found by the UNR field school on the Gund Ranch in the northern part of the valley during the early summer of 1982, on a spit extending out into Pleistocene Lake Gilbert. The archaeological record of the southern part of the valley also suggests a continuous occupation from that early period through the Medithermal and well into the historic period(Clewlow and Pastron 1972). Site types documented in the same area include occupation sites(large villages, camps, rock shelters), hunting sites (lithic scatters), gathering sites (pottery, milling stones), and such special purpose sites as quarries and workshops. The sites are distributed in such a way as to suggest small foraging bands exploiting resources in both the uplands and the valley floor from base camps. In the northern part of the valley preliminary surveys on the UNR Gund Ranch have located task sites originating in hunting, tool repair, and tool manufacture on alluvial fans, on Pleistocene and Holocene shore features of the Lake Gilbert, and on alluvial flats(Elston 1980: 67). In addition, base camps have been located on Pleistocene shore features of Lake Gilbert and on the alluvial flats of the valley floor(Elston 1980: 67). The Gund Ranch surveys also suggest that the large village sites found in the southern valley are missing in the northern valley, as is evidence of a prehistoric subsistence pattern based upon lacustrine resources(Elston 1980: 68). Finally, Clewlow and Pastron(1972) propose that, based upon the archaeological record of the southern valley, there is a general trend over time toward increasing dependence upon plant gathering and less dependence upon hunting in the Grass Valley region.

A tentative model for prehistoric land use in the Cortez mining district is suggested by the previous archaeological work in Grass Valley. Task sites associated with hunting, gathering, tool repair, and tool manufacture are expected in the vicinity of springs and streams, especially in the lowlands. No large village sites are expected. The expected chronological sequence extends from the end of the Pleistocene into the historic period after the 1860s, perhaps as late as 1920. And the archaeological record of the district is expected to illustrate a shift from a subsistence pattern dominated by hunting to one in which gathering of plant resources is much more important.

THE CORTEZ MILL STUDY UNIT(1863-1886)

The Cortez mining district was founded in March, 1863, by a group of eight prospectors , which included Andrew Veach and Simeon Wenban(Bancroft 1889: 11). Most of the gold and silver bearing rocks that they discovered were contained within the Hamburg dolomite and Eureka Quartzite(the "Nevada Giant") exposed in the "Cortez Window" of Mount Tenabo(Roberts et al 1967: 72; Raymond 1869: 81). Upon establishing the district, the original locators and their backers, which included George Hearst, claimed most, if not all, of the potential lode bearing lands and thereby prevented a rush to Cortez (Reese River Reveille May 3, 1864). Two major mining companies were founded - the Cortez Company centered in Mill Canyon and the Tenabo Company on the western slope of Mount Tenabo(Bancroft 1889: 12-13; Emmons 1910: 101). Prior to 1864, ore was shipped by mule to Austin for milling and refining(Emmons 1910: 101). Then in the latter half of 1864 an eight stamp pan mill was constructed in Mill Canyon by the Cortez Company(Reese River Reveille May 7, 1864). The ore of the Cortez district, however, was not amenable to refinement by the well-known "Washoe" process of pan amalgamation developed on the Comstock. To alleviate the problem, the "Reese River" technique of roasting the ores prior to amalgamation was tried; four reverberatory furnaces were installed at the Cortez mill in 1865(Bancroft 1889: 13). Unfortunately, more than technological refinements were needed, for by 1869 the area was described as nearly abandoned(Raymond 1869: 82). It was repeatedly asserted that poor management of the mill resulted in its unprofitability(Bancroft 1889: 13; Raymond 1869: 82; Whitehall 1875: 47). Simeon Wenban, who owned the Tenabo Company, purchased the Cortez Company mill in 1869 for $6,000(Bancroft 1889: 13; Whitehall 175: 47); it's original cost was $200,000.

Technological Patterns

Archaeological sites associated with milling technology during the Cortez mill period are expected to be derived first from the Washoe process and then from the Reese River process of pan amalgamation. In the May 7, 1864, issue of The Reese River Reveille , published in Austin, is a rather detailed description of what was planned for the mill; that, together with comparative data and descriptions of these milling processes from contemporary metallurgical textbooks(e.g., Egleston 1887; see, also, Oberbillig 1967), forms the foundation of the following model. Ore brought to the mill was first sorted through a grizzly , a metal grate used for sizing; pieces too large to pass through the grizzly were sent to a rock crusher for pulverizing. The ore was then dried in a large kiln. After drying, the ore was finely ground with batteries of California Stamps . At the Cortez mill, 16 batteries were initially planned, but only eight appear to have been installed. Each of the Cortez stamp batteries weighed 700 pounds. Stamps and other mill machinery were powered by a 45-horsepower steam engine made by Vulcan Works; the boiler was tubular, 15 feet long, and 4 feet in diameter, and was made by Coffee and Risdon, San Francisco. According to the newspaper account, the engine was placed upon a foundation of granite blocks and capped with a heavy timber frame. In 1864, ground ore apparently followed the Washoe pan amalgamation process. First, the ore was transported by gravity from stamp batteries to amalgamating pans at a lower level. Here, the ore was mixed with water, salt, copper sulfate, and mercury to form a pulp. During this stage of the operation, silver in the ore combines with mercury to create an amalgam . The amalgamating pans at the Cortez mill were of the Knox-type and 12 were initially planned. Each of the pans weighed 3,000 pounds, was five feet and four inches in diameter, and had a bottom chamber for the admission of steam for heating.

Pulp from the amalgamating pans was then discharged into settlers at the next lower level. Settlers were large wooden tubs with rotating arms in which the amalgam and free mercury settled to the bottom and were drawn off; the settlers at the Cortez mill were supposed to be 12 feet in diameter. In some mills the pulp was further discharged into agitators, somewhat similar in both shape and function to settlers, for additional separation of the amalgam and mercury. And most mills used concentrators, such as blanket sluices with riffles, to make a final effort at collecting amalgam and mercury after the pulp left the settlers or agitators and before it was discharged into a waste tailings pile. Whether these pieces of equipment were used at the Cortez mill is unknown. The amalgam, after collection, was put into a retort furnace where the mercury was vaporized, leaving silver bullion. Usually, the vaporized mercury was then condensed and used again.

Social and Demographic Patterns

Virtually nothing is known from documentary sources about the social life of the Cortez Mill period miners. Cornish, Italian, Mexican, and Chinese ethnic affiliations are mentioned, along with Native born. Chinese were apparently the dominant group by the end of the period; they are discussed in more detail in the following study unit. Nor is much more known about demography. There does not appear to have been a "population explosion" of the kind experienced in some other mining districts, principally because all of the most likely localities were claimed by the original discoverers and because of early technological problems in extracting the ore. Population size did increase gradually through the period, however. Initially, settlement seems to have been mostly concentrated in Mill Canyon but later mining camps were established at Saint Louis and Shoshone Wells on the western side of the Cortez Mountains near the Nevada Giant. A more detailed history of these early settlements is given in the section on "1981 Excavations at Shoshone Wells."

Ecological Patterns

Documentary sources also give little information about the ecology of the Cortez Mill period. Certainly, however, some of the raw material networks were established during this time, especially salt and wood. Piped-in water was not, however, part of the Cortez Mill ecology; the mill was, in fact, located in Mill Canyon because of relatively abundant water there. The model of ecological patterns outlined in the following study unit provides a standard against which ecological patterns in this period can be measured.

WENBAN'S MILL STUDY UNIT(1886-1915)

In 1886, Simeon Wenban built a new mill near the Garrison Mine(Bancroft 1889: 16; Figure 2). The mill revolutionized many of the technological, demographic, social, and ecological patterns in the Cortez district and, for this reason, underlies the definition of a distinctive study unit. Initially, Wenban's mill had a daily milling capacity of 50 or 60 tons of ore and used the Russell leaching process, an innovative, cost-efficient technology developed from experimentation at the Mount Cory(Nevada) and Ontario(Utah) mills(Eissler 1898: 282).

In 1888, Wenban formed the Cortez Mines Ltd in London to incorporate his holdings "so that in case of his death it would be in better shape than if he held it as an individual"(Reese River Reveille December 12, 1888). In addition to his involvement with the mines and mills of Cortez, Simeon Wenban also operated a grocery and dry goods store(Wenban 1887-1888). The Wenban holdings were sold to the Cortez Mines Ltd in 1888 for $290,000; these included 29 mines, two mills, his house, wood, timber lands, office, barn, stable, carriage house, boarding house, tailings, artesian wells, horses, mules, teams, wagons, and furniture(Lander County 1888: 62-76). During the period between 1889 and 1892, the Bewick-Moering Syndicate of England was in charge of the Cortez operation (Lincoln 1922: 80). After that time, Wenban once again took over. The mill, however, apparently closed in 1892 and all operations ceased in 1895(Weed 1922: 1173).

Wenban died in 1901(San Francisco Chronicle March 5, 1901). In 1902, the Cortez operations were restarted on a smaller scale by Buckhorn Kearns Consolidated Gold Mining and Reduction Company and a variety of other companies, including the Bullion Hill Mining Company, Cortez Metals Recovery Company, Keystone Exploration and Development Company , and Tenabo Mining and Milling Company (R.L. Polk 1912). In 1908, the Cortez Metals Recovery Company converted Wenban's mill into a 100-ton cyanide leaching plant; the mill was burned in 1915(Weight 1950).

Technological Models of Wenban's Mill

The known history of Wenban's mill suggests that two technological processes patterned the tools used and the activities taking place at the site: Russell leaching and cyanide leaching. Each process has some distinctive archaeological expectations and some that are held in common and are, therefore, archaeologically invisible; however, installation of the cyanide leaching process in 1908 implies that only remnants of the earlier Russell process are likely to exist. At least, that is an hypothesis to be tested. As discussed earlier, the two technological models to be outlined here are ideal . They are based upon a study of historical evidence and comparative data. The deviation between what the ideal models predict and what is actually observed in the archaeological record is a source of future research problems.

The Russell Leaching Process Model. Leaching, or lixiviation, of ores, in which silver compounds are dissolved in a chemical solution and then precipitated, was commonly used during the latter part of the 19th Century on poor ores, to rework tailings from earlier pan amalgamation mills, and when pan amalgamation lost too much silver to be profitable(Stetefeldt 1895). By the early 1880s, the Von'Patera method of lixiviation had been

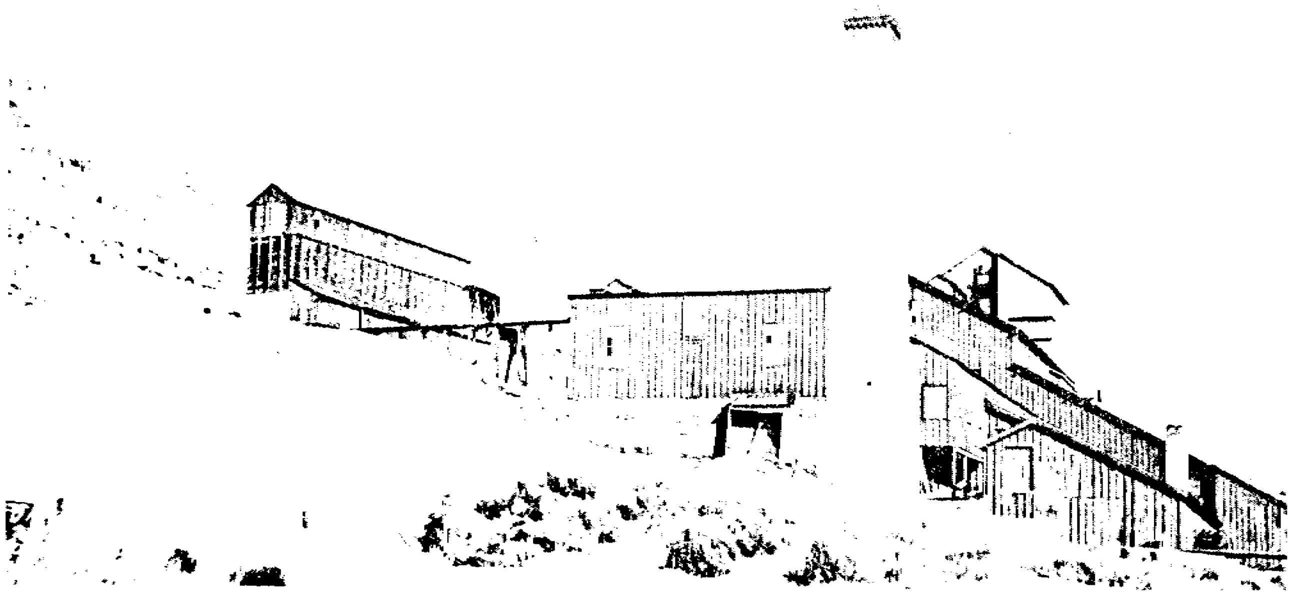


Figure 2: Wenban's Mill About 1907. Courtesy Nevada Historical Society.

installed in several silver mills in the western United States. This method typically involves a seven-stage treatment of the ore, as reflected in the Bertrand Mill operation near Eureka, Nevada (Egleston 1887: 487-515): crushing and drying the ore, roasting the ore with salt to produce chlorides, leaching out base metals with water, leaching with sodium hyposulfite, precipitation of the resultant solution with calcium or sodium sulfide, and roasting the precipitant(silver sulfide) to drive off the sulfur and leave silver bullion. The Von Patera process is impractical, however, on ores with a relatively high percentage of lead; leaching with sodium hyposulfite brings both silver and lead into solution and produces a precipitant of both elements that is difficult to refine(Eissler 1898; Stetefeldt 1895). Lixiviation using the Russell process eliminates this problem. It also demands that less than 100 percent of the ore be converted to chlorides during roasting. The method involves leaching the ore with a mixture of sodium hyposulfite and cupreous hyposulfite after it has been dissolved in a straight sodium hyposulfite solution(Stetefeldt 1895).

Bancroft(1889: 20) describes the Russell leaching process technology at Wenban's mill as new and highly innovative and stipulates the ore treatment stages. This description can be used as a specific model of what can be expected archaeologically. The first stage in the milling process was to dry and crush the ore in a manner similar to that described for the pan amalgamation method. Then the ore was passed to Krom rolls rather than to stamps for fine grinding. Krom rolls were installed because they are cheaper to buy, less costly to maintain, self-contained and therefore required no separate building; lixiviation allows their use by not demanding the exceptionally finely ground ores used in pan amalgamation milling(Egleston 1887: 210-226). After grinding, the ores were sorted with revolving screens and the coarser ores returned to the rolls. Correctly sized ores were conveyed to a furnace for roasting with salt, as described for the Reese River variant of pan amalgamation. Thus far we have been unable to determine whether the furnace was a Stetefeldt shaft-type or another kind, such as the Bruckner's cylinders used at the contemporaneous Bertrand mill(Egleston 1887: 487-515). One group of foundations at the mill site, however, is associated with what may be part of a Bruckner cylinder. After roasting, the ore passed to leaching vats where it was dissolved in solutions of water, bicarbonate of soda, sodium hyposulfite, and cupreous hyposulfite. At the Bertrand mill, the leaching vats were wooden tanks six feet in diameter and three feet deep; 24 of the vats were used. The dissolved ore was then conveyed to precipitation tanks , where lime and sulfur were added to form calcium sulfide and to precipitate the silver as silver sulfide. Precipitation tanks at the Bertrand mill were eight feet in diameter, 12 feet deep, and were constructed of boiler iron. The precipitant was then forced through a filter press, dryed, and roasted in a cupellation furnace to drive off the sulfur.

Cyanide Leaching Model In 1908, Wenban's mill was refitted with a cyanide leaching technology to more efficiently rework the old mill tailings; the mill was apparently operated until it burnt in 1915(Weight 1950: 11). No specific information about this period of the mill could be found. For this reason, a general model of cyanide leaching technoloy, derived from comparative study of other mills and metallurgical textbooks, is proposed, from which can be drawn a specific set of hypotheses and test implications for the archaeological record of Wenban's mill. In this milling process, potassium cyanide and later sodium cyanide was used to dissolve the ore, and zinc shavings or dust were used to precipitate the silver(Dorr 1936). The method was first applied to gold but experiments at the Sirena mine in Guanajuato(Mexico) in 1900 demonstrated that cyanide could also leach the chloride and sulfide compounds in which silver almost always occurs(Dorr 1936: 4). Vanderburg's(1938: 27) discussion of the Robert's Mining and Milling Company operation in Mill Canyon gives the general pattern of cyanide leaching technology, although this mill is considerably smaller(only a 20-ton capacity) and 30 years later than Wenban's. First, the ore is crushed, mixed with a solution of sodium cyanide and lime, and ground finely. A Blake crusher, conveyor belt feeder, and Marcy ball mill were used for these purposes at the Roberts mill. The ground ore was then passed through a size sorter or classifier . Ore that was too coarse or too heavy("sand") was ground again; the remaining "slime" was discharged into a large tank with rotating mechanical arms or rotors called a thickener . Here, ore particles that had not gone into solution settled to the cone-shaped bottom and flowed out into one or more(in a series) of agitators . The agitators were also large tanks with mechanical rotors and were used simply to keep solids in suspension so that they could be dissolved with sodium cyanide. Two agitators in a series were used at the Roberts mill. After agitation, the entire solution was once again sent to a thickener, where the process begins anew. Dissolved ore from the thickeners was allowed to flow over the top of the tank and into some kind of precipitation system . Successive stages in the system filter the solution, add zinc dust, add lead acetate(to speed up the process), and force the solution through filters to remove the precipitant. The Roberts mill used vacuum- leaf filters, three precipitation tanks, and Merrill-Crowe bag type filters to capture the silver.

Social and Demographic Patterns

From its inception, the Cortez district apparently had problems finding workmen for the mines and mills. Even with relatively high wages of $75 a month with board or $5 a day without board, in 1864 workers were in demand(Reese River Reveille May 3, 1864). Sometime after 1870 and completion of the Central Pacific railroad, large numbers of Chinese immigrants were brought in as laborers, including hardrock miners, and completely replaced the "turbulent and riotous" Cornish workers (Bancroft 1889: 18; Walker 1872: 199; Whitehall 1875: 47). For whatever reason they were employed(cheap labor, Wenban's debt to Chinese backers, pro Chinese stance of Wenban), Chinese laborers apparently remained until at least the early 1900s(Annon. 1908; Knudtsen 1975; Labbe 1960; Murbarger 1963: 34; Weight 1950: 10).

The 1900 census records provide additional information about the ethnic composition of the district(Table 1). At this time, Chinese comprised the single largest ethnic group. Their principal occupations included mine laborers(38), mill laborers(19) and hands(6), store keepers(3) and clerks(2), cooks(3), laundry workers(3), seamstresses(2), barbers(1), day laborers(1), mechanics (1), butchers(1), tool packers(1), and blacksmith helpers(1). Although two of the women were married, there were no children listed in the records. The census taker distinguished between the head of the family, partner, and boarder. Most Chinese in the Cortez voting precinct were mill laborers listed as boarders and presumably lived in the large boarding house near Wenban's mill; those living in the Garrison precinct were mostly mine laborers listed as partners and presumably lived on the terraces around the waste dumps of the Garrison mine. Such a distinction may indicate an organized work force or Chinese "company"(partners) at the Garrison mine, while Chinese at the mill were employed as independent laborers. A further distinction between inhabitants of the two precincts is the greater number of Chinese owning(11) or renting(1) their houses in the Cortez precinct versus a few rentors(6) and no house owners in the Garrison precinct. The large number of Chinese without rented or owned houses probably reflects the prevalence of boarding houses in both precincts. In 1900, no Chinese are listed as ore miners, a title reserved for foreign born and native born Whites. The year of entry for Chinese is varied and ranges from 1856 to 1885, two years after the Chinese Exclusion Act. Most immigrated in the mid- to late-1870s and early 1880s, however. Two women are native born Chinese-American and one of them is listed as a 50 year old born in 1849 to an immigrant father and native(California) mother. The woman(of possibly mixed descent) is listed as a laundress whose name is Mahea J...fe; she is a single head of household and owns her house. Mahea, of course, is not a Chinese family name, although it may be Polynesian.

Other ethnic groups may also have been in the Cortez district during this period. Whether or not the earlier Mexican presence is continued must be decided by future historical and archaeological research. The adobe structures at Shoshone Wells and Upper Cortez, which were initially thought to have been occupied by Mexicans, were probably occupied by a variety of ethnic groups during the early mining period; however, at least one such structure at Shoshone Wells may be associated with a fragment of majolica ware, suggesting a Mexican presence. Italian and other Mediterranean Basin woodcutters and charcoal makers have been mentioned in historical sources(see, for example, Weight 1950: 10), and their presence at Shoshone Wells is suggested by a couple of outside bread ovens and a few other distinctive artifacts. And employment of Native Americans by the Tenabo Company to gather salt in marshes around Lake Gilbert in Grass Valley has been mentioned by at least one historical source(Murbarger 1963: 46). The 1981 project did not encounter archaeological sites of such activities, but a UNR range scientist is rumored to have found one on the Gund Ranch. At Shoshone Wells, however, the archaeological record does support the presence of Native Americans, but the component has not yet been definitely attributed to the historic settlement. Finally, some historic photographs, oral histories, and the 1900 population census document the presence of a substantial community of Blacks in the Cortez district around the turn of the century. Little is yet known about the geographical distribution of ethnic populations, beyond that mentioned above. The archaeological site of Shoshone Wells suggests distinctive ethnic "neighborhoods" that are geographically separated; however, the site chronology is not yet worked out, so it is possible that the ethnic settlements are not contemporaneous. A number of Chinese settlements are rumored to be clustered around the Garrison mine. To date, however, the only archaeological evidence is several terraces upon which house foundations are sometimes visible, some of which have been covered by the waste dump.

Ecological Patterns

Adaptive strategies used to cope with variable ore bodies help to understand changing patterns of ecological relationships throughout the district. Technological innovations make new demands upon sources of materials, energy, and information; indeed, the adaptive fitness of the innovation may depend as much upon availability of cheap energy and materials to support it as upon its effectiveness in acheiving a given task. Whenever an innovation, such as the Reese River process, is successfully introduced, new patterns of environmental interaction are created for logistical support. Each key innovation in mining behavior is, therefore, the key to making predictions about where related archaeological sites are likely to be found and what kind of activities they represent. The primary ecological demands during the Wenban's Mill period were tied to materials that went into the Russell leaching technology installed at the new mill. These included salt, sulfur, lime, and water. The Russell process had high adaptive value in the Cortez district in part because all of these critical materials could be obtained locally at low cost, and Wenban's mill was integrated into a network of environmental relations centered upon these key resources. Whenever costs of these materials increased, for whatever reason, the adaptive value of the Russell process went down. The following discussion outlines what is known to date about where these critical materials were obtained.

Sulfur . Extensive sulfur deposits occur at Hot Springs Point about 15 miles north of the Cortez mines(Roberts et al 1967: 114); the sulfur is associated with gypsum and iron oxides and "forms veins and breccia filling sporadically distributed in fractured and altered rock"(Roberts et al 1967: 114). There has been exploration but no production in recent years. Whether or not sulfur from Hot Springs Point was used in Wenban's mill is unknown, but archaeological work in this region might answer the question.

Salt . Two sources of salt in the vicinity of the Cortez mining district have been identified. The largest and best documented historically is at Williams salt marsh in Diamond Valley. Angel(1881: 436) make the following observations about the marsh: (1) it covered about 1,ØØØ acres; (2) salt incrustations on the surface could be gathered but contained only about 6Ø percent pure salt; (3) in the early 188Øs, 95 percent pure salt was collected from the marsh by drawing water into 22 evaporation pans each of which was 1Ø feet long, 4 feet wide, and 1Ø inches deep, and each of which was artificially heated. About 5,ØØØ pounds of salt a day was manufactured in this way and sold for 2 cents a pound.

The other source is not well documented but is only a few miles away from the Cortez district: the marshes around Lake Gilbert in Grass Valley. Contemporary newspaper accounts suggest that a Henry Williams operated a salt gathering operation in this area in the late 186Øs. Whether or not the rumored Native American salt works in this area are part of the Williams operation is at present unknown. It is entirely possible that Wenban employed salt gatherers directly rather than going through a more expensive "middleman."

Lime . Wenban's mill manufactured lime on the mill site. Limestone was quarried and a kiln built just above the mill(Figure 3) and another kiln, in Cortez Canyon, may have been associated with the mill.

Water . Scarcity of water in the immediate vicinity of Wenban's mill forced allocation of significant capital resources to bypass this physical constraint. During the earlier Cortez Mill period, water was carried by pack train three miles to the steam hoist engine at the Garrison Mine(Angel

Figure 3: Lime Kiln at Wenban's Mill.

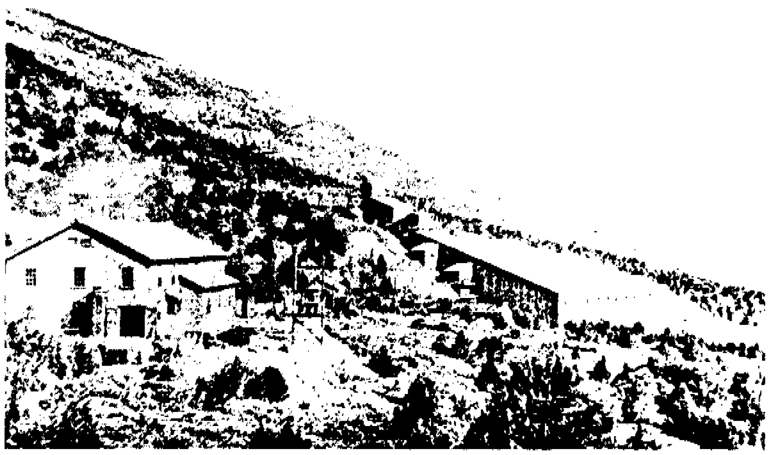


Figure 4: Consolidated Cortez Mill in the 1920s. Courtesy MacKay School of Mines, University of Nevada Reno.

1881: 429). Upon completion of Wenban's mill, however, some water was piped from a spring seven miles away on the other side of Grass Valley. Additional water was obtained from two artesian wells that were drilled on the valley floor; this water was brought to the mill with a Worthington pump(Bancroft 1889: 17; Emmons 1910: 101).

Wood . Italian woodcutters and charcoal burners are mentioned in documents pertaining to this period. Cordwood and charcoal were used especially in running the steam engine and furnaces in the mills. Most of the wood was apparently cut in pinyon-juniper uplands of the Cortez Mountains; however, the extent to which it was deforested is unknown.

THE CONSOLIDATED CORTEZ STUDY UNIT(1919-1930)

In 1919, the Cortez mines were purchased by the Consolidated Cortez Silver Mines Company, which developed the Arctic Mine and constructed a large mill nearby(at the mouth of Arctic Canyon) with a daily capacity of 125 tons(Figure 4); in 1927, the mill was converted to oil flotation (Gilluly and Masursky 1965; Hezzelwood 1930; Vanderburg 1938). The Consolidated Cortez operation was top silver producer in the state of Nevada by 1928, but crashed in 1929, when the price of silver dropped to 48.7 cents an ounce(Weight 1950: 11). In 1930, the company passed into receivership and remained there until 1937, when it was bought by the Cortez Metal Company (Vanderburg 1938: 22). This period is tentatively treated as a separate study unit because of some expected changes in technological, demographic, social, and ecological patterns.

Technological Patterns

A systematic approach to underground mining was developed during this period and is well described by Hezzelwood(1930). There is relatively little known about underground mining in the Cortez district prior to the Consolidated Cortez operation. Emmons(1910: 103), however, provides some information. The complex 3-dimensional support in the form of an open cube that was required in the Comstock mines because of unstable, fractured rock was not necessary at Cortez. Almost no support was needed in the passages providing access to the stopes(Hezzelwood 1930: 3). The main ore body outcropped on a long cliff face from which a series of adits could be driven to follow the ore body directly or to intersect where the ore body was projected to be. Another method of ore exploration in the Cortez district was to drive lateral drifts(horizontal passages connecting shafts or exploring ore bodies) from shafts. The main adit in the Cortez mines before the 1920s was the Garrison or Number 1 level at 7,055 feet above sea level; the most extensive mining took place from this level (Emmons 1910: 103). Drifts, cross-cuts, and raises make up a total of seven levels of underground workings at the Garrison Mine. In the early 1920s, the Arctic Tunnel was driven into the cliff face at 6,701 feet above sea level almost 2,000 feet into the side of Mount Tenabo. From this adit, another significant ore body was mined through a network of drifts, cross-cuts, and raises.

Hezzelwood(1930) provides the following information about deep mining methods at the Consolidated Cortez. The "shrinkage" method of stoping was used. Here, ore bodies to be worked are laid out in sections of 100 and 125 feet with "manway" raises - shafts through which miners work - at each end. The manway raises are driven up 25 feet from a drift excavated just beneath the ore body section and in which the ore transportation system has been constructed. Next, four chute raises were driven at 24 feet intervals parallel to the manway raises, and chutes were constructed through which mined ore would be dropped into cars waiting below. The final step was to drive a drift between manway raises about 15 feet above the transport tunnel floor. Stoping then began by blasting slices from the top of the drift and letting the loosened ore fall through the chute raises; one miner worked from each manway raise toward the other. "Overhand" stoping of this kind was continued upward, stopping when the stope was within 15 feet of the next highest level. At the Consolidated Cortez mines, the shrinkage system was used because of cheapness(no shoveling, little timbering, and no waste filling); because it was easier to follow a poorly defined ore body; and because it was safer(miners are always working close to the top of the stope, allowing close inspection so that falling rock can be avoided more often.) The system, however, could be used only when the ore body was structurally strong, when it had a steep vertical inclination so that the loosened ore could fall directly into the chutes without shoveling, and when it was unnecessary to do crude sorting of the ore. In addition, the method tied up large amounts of broken ore as support during the stoping operation, creating problems in hauling enough ore tonnage to the mill unless the ore body was quite large.

Development of underground mining is controlled partly by the distribution of the ore body and partly by the engineering problem of the most efficient way of gaining access to the ore body(Young 1970: 155ff). One early mining pattern was the Spanish "rat hole" method, in which a single shaft or adit was used to gain access to the ore body and a maze-like network of drifts and raises was used to follow the body; this system is still used in small mining operations. In contrast is the well-organized system of shafts and adits in large mines through which access to the ore body can be gained and ore removed efficiently - this system demands that mine managers acquire knowledge about the shape of the ore body before the mining operation is planned and begun. The extent to which this is possible varies from mine to mine. For archaeological purposes, it is also important to note that mining activities taking place in adits and shafts are mostly connected with "entrance, access, ventilation, and transportation" (Young 1970: 154); some inside passageways such as cross-cuts and raises are also used for communication, ventilation, and access. Actual mining activities take place mostly in working drifts within the ore body, in chute raises connecting the stope to the working drifts, and in some exploratory lateral tunnels and shafts. The archaeological expectations vary accordingly.

Ore transportation is another "sub-system" of human activities that structure the archaeological record of underground mining in the Cortez district. Underground ore transportation involves two kinds of activities: moving ore from one place to another on the same mine level, and moving ore from one mine level to another. The most efficient mine operations worked from the bottom of the ore body to the top so that energy expenditure could be minimized in moving the ore; the shrinkage system of stoping is typical. Here, broken ore was dropped into cars through chute raises. Early ore cars were almost always of one-ton capacity and pivoted so that they could be dumped either from the end or from the side(Young 1970: 161-162). The cars ran on tracks built on the floor of each mine level and in the 19th Century were usually pulled by small mine mules in trains of four or five. At the Consolidated Cortez in 1929, the adit level ore trains were six cars long and were pulled by a three and one-half ton storage battery locomotive(Hezzelwood 1930: 11); the cars each held 50 cubic feet of ore and were of the gable-bottom, side-dump type. The track was 24-inch gage with 30-pound rails and four by six inch wooden ties.

Hauling ore from one mine level to another was done either through shafts or incline passages through which ore "skips" were hoisted or pulled. Early hoisting methods used a hand-turned windlass to pull a hemp rope, one end of which was attached to a bucket or skip; somewhat later horse "whims" were used to do the same thing. By the latter part of the

19th Century, these hoisting devices were being replaced by headframes, steam hoist engines, and flat braided wire cables. The hoist engine was housed in an engine house near the headframe; a wire cable ran from the engine to a sheave(circular drum) at the top of the headframe down the shaft or incline to the skip car(Young 1970: 153). Smaller versions of these hoisting arrangements were used to haul ore from one mine level to another. Although virtually nothing is known about underground ore transportation in the Cortez district prior to the 20th Century, Hezzelwood (1930) again provides specific information about the 1929 Consolidated Cortez operation. The following equipment was used to bring ore from the lowest levels to the Arctic adit at the 6,701 feet level: an 18-cubic feet skip car; a three-quarter inch, six-strand hoisting cable; a five-feet diameter steel sheave; and a 50-horsepower, 220- volt hoisting engine.

The milling pattern marking the Consolidated Cortez period is essentially identical, technologically, to the cyanide leaching model described for Wenban's mill. Discovery of a set of photographs entitled "Cortez by Kodak" in the MacKay School of Mines at the University of Nevada, Reno, greatly facilitated the development of a specific model of the Consolidated Cortez mill. Presumably taken in the early 1920s, the photographs show details of the mill and powerhouse interior. The mill was powered by two 200-horsepower, semi-diesel engines, which were direct-connected to electric generators; the powerplant also contained three fuel oil burning air compressors rated at an additional 250 horsepower. At least one of the compressors was a Sullivan angle-compound type according to notes on the photograph. And at least one of the diesel engines was manufactured by Fairbanks and Morse. Electric locomotives transported the ore from the Arctic Tunnel to the mill, where the ore was fed by automatic feeder into an Allis- Chalmers gyratory crusher. After preliminary crushing, the ore was run through an Allis-Chalmers ball mill, which reduced the ore to less than 40 meshes per square inch size. From there, the ore passed through an Allis-Chalmers tube mill for sliming to a maximum size of less than 100 meshes per square inch. A Dorr classifier was connected in closed-circuit to the tube mill. Probably after tube milling, the ore was sent to concentrating tables, where almost half of the bullion was recovered before cyanidation, again according to notes on the photographs. A Merrill clarifying press is shown in the system to remove sediments before zinc dust was added to precipitate the cyanide solution, and Oliver filters are shown recovering the last traces of silver after precipitation and before the slime is discharged into the tailings pile. Finally, the photographs demonstrate that the cyanide precipitant was melted by a fuel oil burning tilting furnace; notes indicate that 1,000 ounce ingots were cast.

The Consolidated Cortez mill was modified in 1928 to use the <u>oil flotation</u> method of ore concentration(Vanderbur 1938). Here, "frothing" <u>machines</u>, such as the Fagergren flotation cells are used along with chemical frothing agents, such as pine oil, to float small silver particles. The flotation process was usually used in combination with cyanidation, which loses more silver than gold; in most cases, exhausted mill tailings were run through the flotation cells to recover additional silver. Installation of the flotation system is not expected to have much impact upon the archaeological record of the mill's earlier technology.

<u>Social and Demographic Patterns</u>

To date, little is known about social and demographic characteristics of this period. Most of the earlier settlements seem to have been abandoned in favor of "Upper Cortez" in the vicinity of Wenban's mill. And the small settlement around the Garrison Mine was probably also abandoned as the principal locus of mining activity shifted to the Arctic Mine. The settlement of Shoshone Wells was most likely vacated after Simeon Wenban left the area, as it seems to have housed a number of domestics in Wenban's employ. As for ethnic composition of the district during this period, nothing is known. It is expected, however, that distinct patterns of ethnic behavior are probably archaeologically invisible, unless relatively recent immigrant groups worked in the area. Native-born Blacks, for example, who are expected during this time period, are not expected to have a distinctive archaeological pattern.

Ecological Patterns

A major change in the human ecology of the district is expected during this period, or somewhat earlier. One major change is in the shift from woodburning steam boilers to diesel fuel burning electric generators. As a result, the deforestation of the Cortez uplands should have been greatly reduced, and a new surge of forest growth started. The second major change is in the network of raw materials. Local and regional networks bringing salt, lime, sulfur, and the like to the mills are expected to be replaced by national networks through which diesel fuel and cyanide are transported to the Consolidated Cortez mill.

THE POST-CONSOLIDATED CORTEZ MILL STUDY UNIT(193Ø-PRESENT)

After the Consolidated Cortez Silver Mines Company passed into receivership in 193Ø, the Cortez mining district was marked by only sporadic and small scale mining activities. In 1937, the Cortez Metal Company purchased the property of the Consolidated Cortez but did not operate the mine(Vanderburg 1938: 22). Only small leases were active during this time. The Roberts Mining and Milling Company did, however, operate a substantial mill in Mill Canyon for a short time in the late 193Øs. Vanderburg(1938: 27) observed the mill in operation and describes it as a 2Ø-ton cyanide leaching plant using the process given earlier as a model for the refitted Wenban's mill. The following equipment was associated: a Sullivan portable air compressor, an Ingersoll-Rand stationary air compressor, a Sullivan drill sharpener, rock drills, a blacksmith shop, a gravity-type tramway, two automobile trucks, an assay office, camp accommodations for 3Ø men, a Fairbanks-Morse 1ØØ-horsepower diesel engine to power the mill, and a 22Ø-volt electric generator(Vanderburg 1938: 27). Cortez Gold Mines is presently active in the district, running a large cyanide mill in Crescent Valley and transporting old mill tailings and mine waste to it from the Cortez district. The present low market price of silver and gold are, however, likely to rapidly bring that operation to a halt, along with many others in the area.

During this period, the entire area is expected to undergo depopulation. The greatest "crash" should be at Upper Cortez, although a few continued to live there into the early 196Øs. Mining activity in Mill Canyon during the 193Øs suggests that a settlement shift toward that locality should have taken place. What the ethnic composition of the district is during the post- Consolidated Cortez period is unknown; however, there is no evidence of a distinctive ethnic minority.

Ecologically, the district after 193Ø is expected to continue participation in a national network of raw materials. There is no documentary evidence to date of extensive use of local resources, other than water.

LAND USE ZONES IN THE CORTEZ DISTRICT

The superposition of land use patterns identified for each of the study units discussed above underlies the following model of land use zones for the Cortez district. Each zone is a geographical area with distinctive expectations for past human activities and, therefore, for the archaeological record. The Cortez zones are controlled, for the most part, by localities of critical resources, by topographic patterns, and by localities of "gravity centers" such as settlements and roads. Figure 5 shows the geographical boundaries of the zones that have been defined by the preliminary phase I study of land use patterns in the district.

Ore Zones

The geographical distribution of ore bodies is expected to be strongly associated with mining sites, such as adits, shafts, tramways, headframes, and the like(Figure 6). In addition, because of the limestone matrix of the Cortez ore bodies, both quarries and lime kilns should occur in the same area. Most of the precious metals production in the Cortez district came from fissure veins and mantos (blanket and pipe replacement bodies) within the Hamburg dolomite of the Nevada Giant. Additional ore bodies have been located in the Wenban limestone and quartz veins of Mill Canyon. All of these are part of the Cortez and Crescent Valley fault system(Gilluly and Masursky 1965: 96-97). As stated in the phase 2 Comstock report(Hardesty, Firby, and Siegler 1982: 45), "the actual location of mining/ milling sites in lode strata is most likely controlled by highly complex causes. For that reason, the distribution of such sites is expected to be random within the lode areas." Accordingly, the recommended survey design for sampling the ore zones is a set of randomly placed linear transects.

Hydrologic Zones

As was true of the Comstock district, water is a critical determinant of human activities in both historic and prehistoric study units. If water is not a simple constraint on where human populations are likely to be found, as if often true of prehistoric foragers, it is likely to be associated with behavior and artifacts involved in its transport to another place, as is often true of complex societies. Thus, although mining settlements are often found in localities without permanent water, such settlements are always linked to water sources elsewhere through some kind of supply system. In the Cortez district, subsurface water was brought to miners by constructing artesian wells, and distant water was transported to miners through a pipeline. For that reason, hydrologic zones can be considered as having both natural and cultural boundaries. Hydrologic zones in the Cortez district thus include streams, springs, artesian wells, and pipelines, which are delimited in Figure 5 by USGS topographic map designations. The zones are expected to be associated with historic residential settlements, water transport activities, mills, and a wide range of prehistoric site types. Survey methods recommended for sampling hydrologic zones include circular quadrats around "point" zones, such as springs and wells, and linear transects following linear zones such as streams and pipelines.

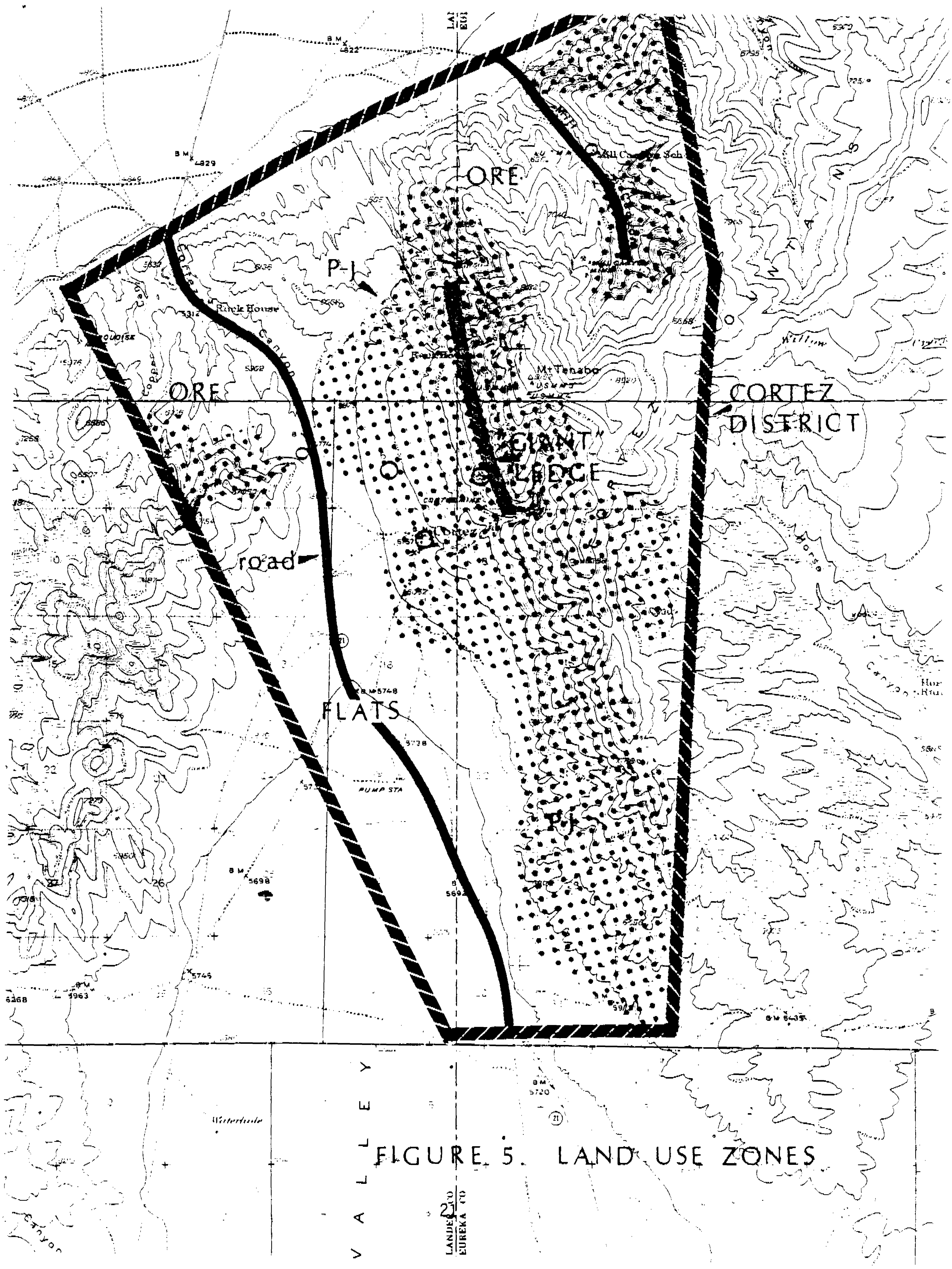


FIGURE 5. LAND USE ZONES

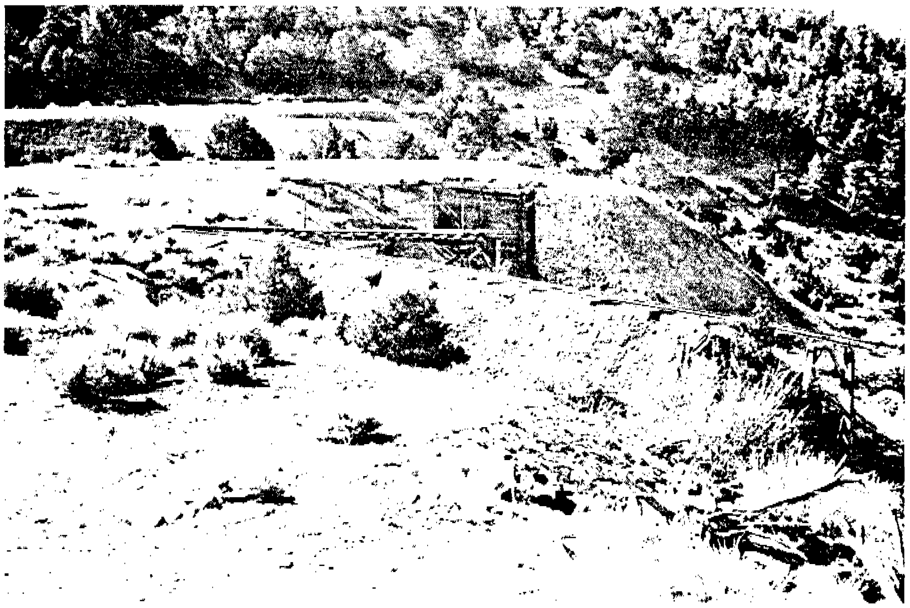


Figure 6: Waste Dumps and the Tramway at the Consolidated Cortez.

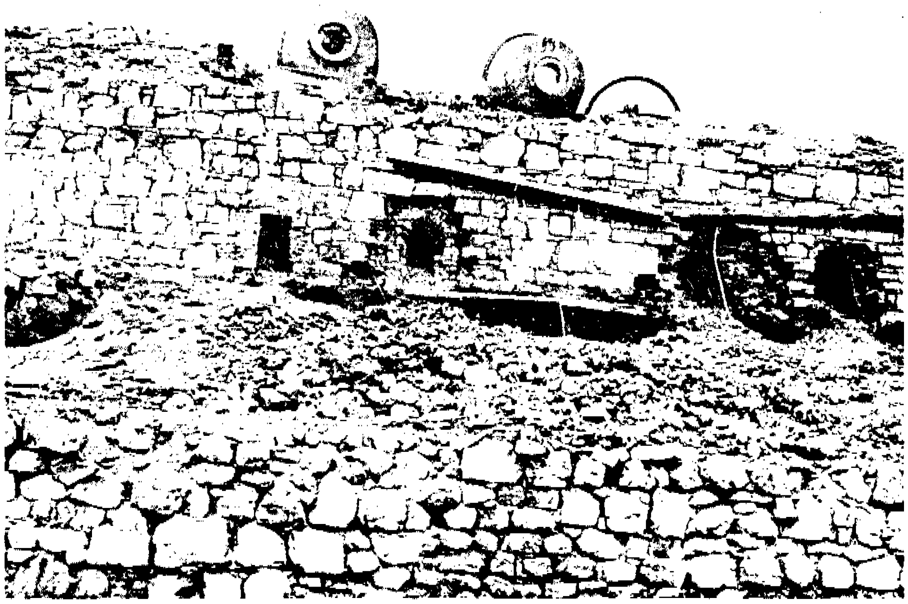


Figure 7: Wenban's Mill Today

Gravity Center Zones

Natural constraints such as the distribution and abundance of water are not the only determinants of land use, especially during historic periods. Roads, sacred places, towns, centers of industrial activities, and the like - all of which have historically complex origins and, therefore, random locations in space and time - serve to attract human populations and activities. For that reason, such places are designated as gravity centers and are treated as separate land use zones within the Cortez mining district(Figures 7 and 8). The most important gravity centers in the district are mining camps. These include Old Cortez, St. Louis, Shoshone Wells, and Cortez(Figure 9). In addition, the Garrison Mine is designated as a gravity center because of the large number of scattered Chinese households that apparently existed in its vicinity(Figure 10). Wenban's household is also treated as a gravity center because of associated households of domestics and other service people. This complex may or may not be part of the old settlement of Shoshone Wells. Historic roads in the district are defined as another category of gravity center. The recommended strategy for surveying these zones depends upon whether the gravity center is a settlement or a road. Settlements are best surveyed with circular quadrats; roads, by contrast, are best surveyed with linear transects.

The Pinyon-Juniper Zone

Above the Cortez mines and mills are uplands covered with a pinyon-juniper forest. During the heyday of the Cortez mill and Wenban's mill, these uplands were heavily exploited for firewood to run steam boilers. Historical sources suggest that Italian woodcutters and charcoal makers were employed in this activity. Consequently, both residential sites of Italian woodcutters and charcoal making sites are expected in this area, in contrast to other places in the district. Specifically, charcoal making sites are expected to be "pit kilns" such as those documented in the Truckee Basin(Elston, Hardesty, and Zeier 1982) and in the Great Basin(Young and Budy 1979; Murbarger 1965). In addition, prehistoric hunting sites and possibly pine nutting sites are expected. The survey design recommended to sample the pinyon-juniper zone is a series of randomly placed linear transects.

Salt Marsh Zone

In addition to water and wood, salt is a critical resource demanded by the Reese River process of pan amalgamation at the Cortez mill and by the Russell leaching process at Wenban's mill. As discussed earlier, at least some of the salt came from the marshes around Pleistocene Lake Gilbert in the northern part of Grass Valley, or at least that is what historical sources suggest. These marshes are here defined as a distinct land use zone because of the expectation of finding archaeological evidence of salt mining. It is possible that such sites may be associated with historic Native American material. The survey design recommended for the salt marsh zone is a set of randomly placed linear transects.

Alluvial Flats

The last land use zone identified in the Cortez district is the "hinterland" on the valley floor or alluvial flats of Grass Valley. Little

Figure 8: The Consolidated Cortez Today.

Figure 9: Upper Cortez. Courtesy Nevada Division of Historic Preservation and Archaeology.

Figure 10: Residential Sites at the Garrison Mine.

is expected in this area, with the exception of seasonal plant gathering task sites and isolated historic artifacts. The main historic road also goes through the area. Randomly placed linear transects are recommended for surveying the valley floor.

SIGNIFICANCE EVALUATION

The study of mining districts is usually left to historians. Certainly historical methods are demanded to develop thematic frameworks from which appropriate behavioral models can be built and to glean the wealth of empirical data about mining technology that exists in written documents, photographs, and maps. At the same time, it does not follow that the goals of research in mining districts should be only historical. Research strategies used can also be directed by goals that are scientific; that is, the purpose of such strategies is not simply to describe or to make empirical generalizations about what happened in the past but to develop universal theories about the past that are independent of particular sets of empirical data. Thus, Dunnell(1980) has discussed the usefulness of the scientific theory of evolution as a research strategy in archaeology, and Kirch(1980) has developed a universal model of behavioral adaptation to explain variability and change in the archaeological record that is derived from evolutionary theory. Kirch's model is "middle range theory"(Binford 1977) that links together general principles of evolutionary theory and empirical data of the archaeological record. The process of adaptation takes place as selection sorts out behavioral variants through differential reproduction to increase those that best solve environmental problems. Adaptive change in the model goes through a predictable sequence of three stages. The behavioral reportoire carried by immigrants into a new environment is, first, expected to have low variability and low initial fitness. Later, efforts to solve key problems in the new environment encourages experimentation and innovative behavior, creating a period of high variability. Finally, selection sorts out these variants and eliminates the least successful, thereby reducing behavioral variability.

An Adaptive Model of Mining Behavior for the Cortez District

A general model of adaptive behavior appropriate for understanding patterns of technological, demographic, social, and ecological change and variability in the Cortez district follows from Kirch's discussion. New mining districts are expected to be colonized by immigrants carrying tools and work patterns best adapted to their homeland. In the beginning, the adaptive fit between mining behavior and the new environment is most likely to be poor, although the degree of fitness is expected to vary. Thus, the Washoe pan amalgamation process for extracting bullion from silver ores was poorly adapted from the beginning in the Cortez district, but was much better adapted to the surface chloride ores in the nearby Reese River district. In that sense, Kirch's assumption of low adaptation at the time of colonization may not be entirely realistic in all cases and in all sectors of human behavior. Mining technology is, however, expected to be relatively standardized and homogeneous on the 19th Century and early 20th Century industrial frontier(Paul 1963). Following colonization is a period of experimentation and innovation in an effort to cope with novel environmental problems. Thus, several roasting, leaching, and crushing/grinding milling methods were tried in the Cortez district after the Washoe process proved to be useless. Finally, variability in mining behavior and tools is expected to be narrowed after some innovations are found to have high fitness in the new environment. Cyanide leaching, for example, nearly replaced other silver milling technologies after the turn of the century.

The adaptive sequence of low variability at the time of initial colonization followed by first an increase and then a decrease in that variability seems to be a useful predictive model for understanding the archaeological and historical records of the Cortez mining district, as well as other districts on the western mining frontier. What the model predicts, however, must be carefully considered within the context of environmental change and variability. Most important is recognition that the ore body itself is the environment that mining behavior tracks most urgently. And, despite the geological constancy of the ore body in most mining districts, it is a constantly changing environment to the miner who has little knowledge of its variability and must search for it as if blindfolded. As each new ore environment is encountered, a new adaptive sequence is set in motion. For that reason, mining as an adaptive process must be viewed as having a strong random component rather than as a simple sequence of colonization-experimentation-adaptation.

Preliminary historical research has supported the usefulness of the Kirch model in understanding some aspects of behavioral variability and change in the Cortez district. The success of mining operations in the district depended largely upon how miners were able to cope with fluctuations in the ore body that were usually unexpected. One early problem was the sudden shift from surface oxidized ores with high silver chloride content, that could be milled with conventional Washoe pan amalgamation, to deeper ores made up mostly of sulfides of antimony and arsenic. The sulfides could not be milled with the Washoe process. Experimentation in the nearby Reese River district demonstrated that roasting the ore with salt before amalgamation solved the problem by converting the sulfides into chlorides. The Reese River process was adopted by the Cortez Company and continued to be used by the Tenabo Company.

Another problem with the ore body in the Cortez district was its sudden disappearance and reappearance or sudden change from high grade to low grade ore. A variety of innovations was tried to solve these problems, some of which were relatively unsuccessful and dropped and a few of which were successful and retained. Diversification in the minerals being mined was one experiment. Rather than mining only silver and gold, the mining companies also recovered zinc, copper, and lead. That was especially true of the Tenabo and Consolidated Cortez companies(Roberts et al 1965: 99). Another such "resilience" tactic is the family-like relationship established by the Tenabo Company with its immigrant Chinese miners. Whenever the ore body was temporarily lost("borrasca"), the company drew upon its pool of familial good will and suspended wages until the ore body was once again located. In such a way cost of the mining operation was minimized.

Another set of innovations was intended to increase the rate of recovery of precious and base metals from low grade ore bodies. Thus, experimentation with the Reese River , Russell leaching , and cyanide leaching processes gradually brought silver recovery beyond 90 percent. And an increased recovery rate rendered profitable reworking of old waste dumps and mill tailings, as well as exceptionally low grade ore bodies in old mine workings. Yet another set of technological innovations decreased the cost of milling and mining methods. The use of calcium sulfide instead of sodium sulfide at Wenban's mill is an example. Egleston(1887: 529- 531) notes that sodium sulfide is better as a precipitator of silver; however, calcium sulfide is cheaper if "lime is counted as next to nothing." Wenban was able to use limestone next to the mill to produce a virtually infinite supply of lime at very low cost. The use of Krom rolls at the same mill also illustrates the importance of cost reduction in the adaptive process. Krom rolls do not grind ores as finely as other methods, such as the California stamp, but are cheaper to buy, less costly to maintain, and do not require a separate building(Eissler 1898: 213-217).

The general pattern of technological and organizational change observed in the historical record of the Cortez mining district is a sudden change in the mining environment followed first by rapid behavioral innovation and then by dropping all but the most successful. That is, of course, the pattern predicted by the Kirch model. Such preliminary observations do not, however, provide a real test of the validity of the explanation. That must come from additional historical research and from observations of the archaeological record, and it is here that part of the "significance" of archaeological sites in the district is derived: (1) ARCHAEOLOGICAL SITES WITH POTENTIAL FOR HAVING CHRONOLOGICAL INFORMATION ABOUT PATTERNS OF VARIABILITY IN MINING BEHAVIOR ARE MORE SIGNIFICANT THAN THOSE THAT DO NOT. Thus, Wenban's mill and the Cortez mill, both of which were used for relatively long periods of time, are more signficant than the Consolidated Cortez mill in terms of this criterion.

Colonization Patterns: Optimal Foraging Models

The nature of colonization on the industrial frontier is another key problem area in the Cortez district that can be used to evaluate the significance of archaeological sites. Elsewhere(Hardesty n.d.), I have proposed that frontier colonization can be understood within the framework of evolutionary ecology. One set of research problems revolves around optimal foraging theory. Here, the issue is whether optimal foraging models can adequately explain the movement of miners from one ore or other resource "patch" to another within the district and thus predict the chronological sequence of archaeological sites at each place. Charnov's(1976) "marginal value theorem" underlies one such model. The theorem stipulates that "the optimal predator should stay in each patch until its rate of intake(the marginal value) drops to a level equal to the average of intake for the habitat"(Krebs and Davies 1978: 43). Average intake is net; that is, the cost of acquiring resources in each patch must be subtracted from whatever is taken. In my paper the model is described as follows:

> The industrial frontier is a web or archipelago of patches...in the form of ore bodies, tree tracts, salt deposits, and the like. Some, such as tree tracts, are renewable; others are nonrenewable. Miners, loggers, and other industrial colonists move into each patch and, according to the marginal value theorem, are expected to stay there until its net yield drops below that likely to be obtained from an "average" patch elsewhere on the frontier. How long they stay, and therefore their rate of movement among patches, is dependent upon rate of patch renewal, variability of the patch, size of the patch, technological efficiency of exploitation("capture" cost), transportation cost, and market price. Minimizing transportation cost and maximizing each of the other variables for each patch type maximizes the amount of time expected to be spent in the

patch and, therefore, minimizes the rate of movement among patches. All but size and variability of the patch are environmental variables that change stochastically. Changes in technological efficiency, for example, may follow the sudden invention of a new milling procedure, such as cyanide leaching, and make patches that had fallen below the average once again profitable to colonize. The prediction of the innovation itself is impossible , as is the prediction of a sudden jump in market prices that would also send the profitability of the patch above average. On the other hand, it is important to note that since market prices and technological innovations are rapidly disseminated throughout the frontier, the profitability relationship among the patches may remain the same even though the average intake line has been raised. In this case, one would expect the patches to be recolonized in exactly the same order as the pioneering colonization.

Development of a specific "marginal value" model of colonization patterns in the Cortez district is planned for the phase 2 project. Archaeological requirements for testing such a model can then be used to assess the scientific significance of archaeological sites in the district.

Victorianism and Cultural Pluralism on the Frontier

The third key research probem domain identified for the Cortez mining district centers upon how American Victorianism is manifested on the Western mining frontier and how it interacts with other contemporary cultural traditions, especially those carried by immigrants and ethnic minorities. American historians consider Victorianism to be the dominant cultural tradition of America during the middle and late 19th Century and perhaps as late as World War I(Howe 1976; Trachtenburg 1982). The tradition is comparable to the American "world views" of Puritanism, Folk culture, and Georgianism used by Deetz(1977) to direct historical archaeological research in the Colonial period. In this case, historians see the Victorian world view as emerging from an urban industrial economy and as having such ideological characteristics as protestantism, the work ethic, punctuality, a strong emphasis upon order, temperance, conspicious consumption, didacticism, and self-cultivation(Howe 1976). The carriers of Victorian culture, mostly of British origin, enjoyed the status of a dominant majority during their heyday and enthusiastically conveyed, by law and missionary activity, their convictions to immigrant and other ethnic minorities. By the early part of the 20th Century, however, these same minorities had become majorities and essentially dominated American cities. Carriers of Victorian culture rapidly disappeared, and America entered a period dominated by a new, multi-ethnic world view.

Baker(1978) has proposed the study of Victorian culture as a key research problem domain for historic archaeology in Colorado; the same approach seems feasible for the Cortez district. The major problem is giving Victorian culture an archaeological identity, as Deetz(1977) has done for the Puritan and other early American cultures by using ceramics, architectural styles, and gravestone styles. That definition, in order to avoid a strictly normative framework, must begin with the study of variability among the carriers of Victorianism in time and space. Baker(1978) has suggested that such a study proceed from the "building blocks" of sites with short-term occupations within which little or no change can be assumed to have taken place. Such an approach allows the building of chronological seqences and geographical series showing change and variability in the Victorian tradition. The archaeological record of the Cortez district is suitable for that approach. Settlements at Shoshone Wells, St. Louis, Old Cortez, and Cortez, for example, may have a series of occupations with distinct spatial and temporal limits that are archaeologically visible; the phase 2 work at Shoshone Wells should go a long way toward clarifying that possibility. And a number of isolated structures scattered throughout the district are potentially useful in this regard. Perhaps the most important is the multi-ethnic composition of the Cortez population. There is every possibility to examine the impact of Victorianism upon immigrant Chinese, Blacks, and other ethnic populations in the district and, conversely, their impact upon Victorianism. In this regard, a major problem is identification of archaeological measures of cultural interaction appropriate for the Nevada mining frontier. At any rate, it is clear that the study of Victorianism provides another criterion for evaluation of site significance at Cortez.

1981 EXCAVATIONS AT SHOSHONE WELLS

The 1981 archaeological project at Shoshone Wells had the following goals: (1) establish a site chronology and link it to the historical record; (2) locate and describe cultural features present; (3) test the features and determine their extent and integrity; and (4) determine the ethnic affiliation of the occupants through architectural and artifactual patterns.

Historical Background

The town name of Cortez has, we believe, actually been applied to at least three different areas in the district. Originally, the townsite of Cortez was established by May, 1864, by the Cortez Company in Mill Canyon(Reese River Reveille May 5, 1864). At this time, there were at least two additional camps associated with the other mines west of Mount Tenabo. Saint Louis was at the foot of the mountain and at the base of a steep trail leading to its namesake - the Saint Louis ledge(Reese River Reveille May 3, 1864). Simeon Wenban apparently lived at or near Saint Louis before constructing his mansion at Shoshone Wells. Shoshone Wells was situated across the valley from Mount Tenabo and the camp of Saint Louis(Reese River Reveille May 3, 1864). In 1864 Shoshone Wells was a small town with six houses and was associated with the Fortune and Cortez American claims under supervision of T.M.Cassell(Reese River Reveille April 7, 1864).

By 1869 the land survey map still shows Cortez in Mill Canyon but nothing else in the district; however, the map does not cover the Shoshone Wells area. Some 19 years later, in 1888, the Reese River Reveille (November 10, 1888) refers to "Upper and Lower Cortez, " which we interpret as present-day Cortez(Upper) and Shoshone Wells(Lower). The name change may have begun with Wenban's purchase of the Cortez mill in Mill Canyon in 1869 and the later construction of his new mill(in 1886) at the present site of Cortez. The shift in mining activity to the west slopes of Mount Tenabo and Wenban's ever-increasing control of the district's operations were undoubtedly instrumental in the name change. Along with the new mill came a piped water supply from Wenban's Spring about five miles to the southwest. This was probably the stimulus that brought about growth in the Upper Cortez area. Sometime before 1889, Wenban built a large house for himself and his family at Lower Cortez; the house included piped water to the kitchen and bath and a green lawn with locust trees for shade(Murbarger 1963: 34).

Methods

To accomplish the stated objectives within the allotted 10 day field project, we immediately surveyed the surface remains and produced a sketch map of the site. An attempt to make a topographic site map concurrently with the excavations was abandoned because of time constraints posed by the short field season and the constant supervision demanded by students in the UNR field school, who contributed the labor. Instead, we settled for a detailed sketch map(Figure 11), which shows major cultural features within the site area. This map was constantly updated during the field season.

The early surface survey revealed spatial patterning among the visible structures and distinct architectural differences among the visible

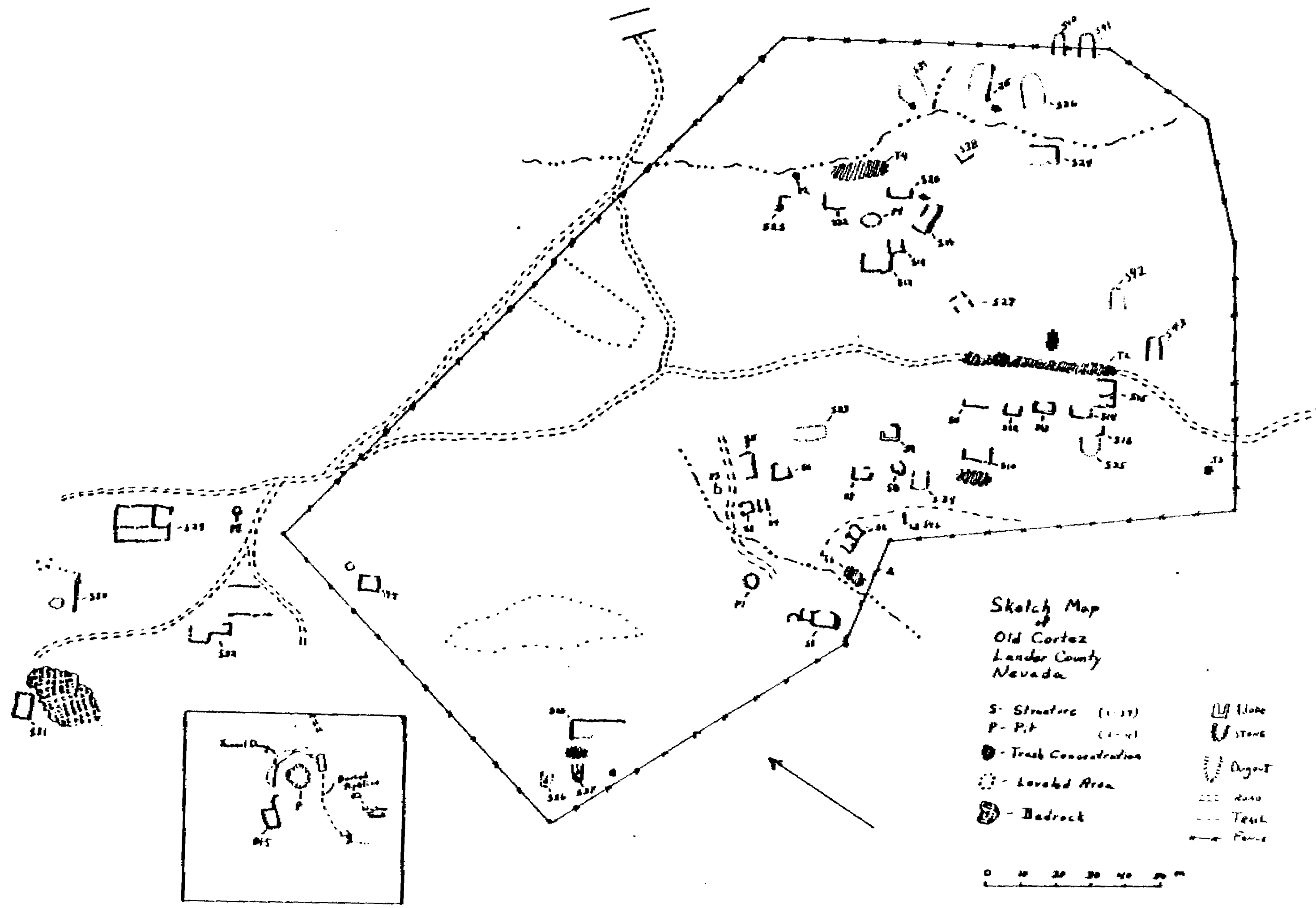


FIGURE 11. SKETCH MAP OF SHOSHONE WELLS

structures. Three principal clusters of structures could be identified. In addition to surface mapping and artifact collection, test excavation of at least one structure from each cluster was conducted. The testing was considered necessary to determine whether the differences among clusters and individual structures originated in sequential occupations, ethnic differences among contemporaneous occupations, or something else. An additional reason for the test excavations was to clarify whether or not the cultural deposits had been significantly disturbed. A bulldozer trench within one building cluster, numerous pot holes, and reports by informed local residents suggested that the site had been vandalized for years.

During the course of excavation, it soon became apparent that the artifact yield would be very small because of low artifact density with building deposits and because of the small volume of dirt moved by an inexperienced crew. To accomplish some of our original goals, therefore, we also selectively sampled trash disposal areas within the site boundaries. These collections were those considered to be diagnostic of chronology, function, and ethnicity. Within each major surface collection area, 100 percent samples were taken from randomly selected areas to provide a reasonably unbiased sample of the cultural deposits.

Limited test excavations were done in four structures. In all cases the test unit was dug to sterile soil. As previously mentioned, the excavations were intended not only to collect artifacts but also to determine integrity of the deposits. Our work suggests that there are indeed pristine cultural deposits dating from the historic occupations of the site. Because of apparent economic cycles in the history of the Cortez mining district, however, it is also likely that some buildings were used over and over again. Such events may not show up in the archaeological record because of the short time span of occupation.

Structures

Forty-five structural features have been recorded within the site boundaries. This figure is, however, probably low because of nearly invisible remains that abound throughout. The dense, high sagebrush, alluviation, simple construction methods, and vandalism have all contributed to such invisibility. Stone and adobe walled buildings are the most visible, and some of these are clustered into "neighborhoods." Other structures which are often hidden from view are dugouts, of which only depressions remain, and stone foundations of wooden frame buildings. Finally, the Wenban house is visible as a deep, stonelined depression on the northwest edge of the site. Other prominent features that have been mapped include wells, trash scatters, roads, and stone alignments that have not been identified.

Adobe Structures Two structures(S9 and S13) are constructed of adobe blocks, each of which is approximately 12 inches by 6 inches by 4 inches; they are laid in two, noninterlocking courses(Figure 12). Although badly decomposed and actively being undercut, the buildings nevertheless have remnants of plaster and whitewash on the interior. The first adobe courses were laid on a low stone foundation. The doorway was most likely in the eastern wall.

Use of adobe appears relatively early in the Reese River district. On

Figure 12: An Adobe Structure at Shoshone Wells. Courtesy Nevada Division of Historic Preservation and Archaeology.

Figure 13: A Stone Structure at Shoshone Wells.

May 1, 1864, the Reese River Reveille reports "numerous" adobe brick yards in Clifton and elsewhere. It also noted some of the advantages of adobe over wood and clay brick, including cheapness, fire resistance, and ease of manufacture and use.

This traditional Southwest building material may be related to the presence of Mexican Americans in the district(three are documented in the 1900 census record for the Cortez district), although diagnostic artifacts are scarce. Furthermore, the listed occupants of adobe buildings in the Reese River district do not have Spanish surnames(Reese River Reveille May 1, 1864). For the present time, therefore, the adobe buildings at Shoshone Wells, and those at Upper Cortez, must be considered as probably early but not necessarily of Mexican origin.

Stone Structures By far the most prevalent structural remains on the site are from stonewalled buildings(Figure 13). This is probably because of readily available stone in the district, because stone buildings cannot be easily moved, and because they preserve better than other construction methods. Actual building styles vary considerably, but certain trends are visible. Angular cobbles of native volcanic rock are used. There appears to be little or no attempt to dress the stone, and there is a wide range of variation in construction methods. In general, however, the dry laid masonry consists of randomly sized stones caulked with smaller stones and mud. Small and high window openings and some door sills still remain; these are wooden, although in at least one instance (S31) clay bricks have been used.

Construction of single unit dwellings is most common. There are, however, examples of multi- room buildings with common walls. At least two of these contain integrated stone fireplaces. Little evidence of roofs remain, but it is likely that most had a central beam and a gable with wooden shingles. One structure to the northwest of the site was built against a large exposed bedrock outcrop, which comprised the rear wall of the building.

Another construction method that left stone structures at the site was to build a wooden frame house upon a low stone foundation. And today only the foundation remains. The scarcity of lumber and the portability of these buildings probably accounts for their invisibility at the site of Shoshone Wells. Some of the wooden frame buildings still standing at Upper Cortez are, for example, reported to have been moved from Shoshone Wells. Simeon Wenban's house was a large wooden frame building with a stonelined cellar. Today only the cellar and stone foundation remain. The house is reputed to have been two stories high, to have been constructed of hardwood and redwood, to have had 12 feet high ceilings, and to have had piped in water (Knudtsen 1975: 185). Outside of the house are the stumps of two locust trees, stone alignments outlining the corral, and a deep stonelined well.

Dugouts A fairly common type of structure at Shoshone Wells is the dugout(Figure 14). These are usually visible as trenches dug into a slope; they seldom occur on level ground. A group of dugouts was located along the banks of the stream, with one of the structures(S24) actually situated in the stream channel. The dugouts probably had their open end closed with a wooden or stone wall and door. Some appear to have stonelined trench walls. Most probably they had little or no wall exposed above the ground, aside

Figure 14: A Dugout at Upper Cortez Similar to Those at Shoshone Wells. Courtesy Nevada Division of Historic Preservation and Archaeology.

from the burm produced by excavating the trench. From artifacts surrounding the dugouts, it appears that they were mostly occupied by Chinese. One structure in particular(S34) is associated with a concentration of opium tin fragments, although this concentration also adjoins the rear of stone structure S10.

Wells Two adjacent trenches dug into the hillside are probably the remnants of a pair of wells. Today only one has a trace of standing water(S37), although a heavy growth of rosebushes and grass suggests the presence of subsurface moisture. The trench with the apparent moisture has stonelined walls and floor.

At about the same elevation as these wells is a mine tunnel with a buried pipeline feeding a water trough. In addition remnants of a second buried pipeline run down the hill and may connect with the Wenban house. This particular contour may be a contact between two rock zones, which is not only a likely location for an ore body but also for an aquifer; the quality of water from such an area is, however, questionable.

Another group of structures are wells tapping the water table in the valley alluvium. There are three, one of which still taps the aquifer. The "wet" well is a large(3.2 meters in diameter) and deep(over 4.5 meters) stonelined structure associated with the Wenban house. If it is the source of piped-in water for the house, it would have needed a water tower or pump, as the water level is well below the elevation of the house. The interior of the well exhibits a very fine job of dry wall masonry, using undressed native stone.

Another stonelined pit is on the bank of the ephemeral stream running through the lower portion of the site. It is considerably smaller than the Wenban well and is presently filled with Chinese trash, including celadon, brownware, and four seasons ceramics; bird bones; hole-in-top cans; cut nails; and opium tin fragments.

Finally, a shallow depression in the middle of a group of buildings may have been a walk-in well. Its gently sloping sides, central location, and proximity to the stream suggest this interpretation. The associated buildings appear to have had Chinese occupants.

Neighborhoods The buildings at Shoshone Wells cluster into at least three groups or neighborhoods, plus the outlying Wenban house and its associated structures. One cluster is a group of five buildings arranged in a linear fashion along the old road through the site(S11 to S15). Possibly associated with this group are several other structures on the opposite side of the road(S27, S42, and S43) and behind the principal line of the cluster(S7-S9, S10, S16, and S35). The cluster includes two adobe buildings and four dugouts. In addition, a linear trash scatter is in the road, along with other scatters adjacent to a dugout(S34) and a stonewalled building(S10). Several piles of broken glass from whiskey and beer bottles are located about 35 meters south of the buildings. These concentrations may reflect a saloon in this neighborhood, especially since household debris is absent. The cluster appears to have been associated with Chinese and possibly with Mexican populations.

The second cluster of seven structures is centered along a drainage running north from the hills behind the project area. These structures are stonewalled and include two multi-room buildings high on the hillside. Below the two structures(S2 and S46) is a trail along the hillside, and a faint roadway appears to run up the hill toward another(S1). Trash scatters in this area are notable for the absence of Chinese artifacts. Discovery of an Italian wine bottle and an outdoor stone oven in the cluster suggests an Italian occupation.

Finally, the third cluster is centered around a shallow depression, a possible walk-in well. The six buildings making up the cluster are of varying size and orientation , but are all associated with Chinese trash scatters. Upstream, to the east, is a series of dugouts along and in the stream bed. These, too, are associated with a thin scatter of Chinese artifacts.

1981 Test Excavations Four structures were test excavated during the 1981 field season: S1, S13, S18, and S2Ø. In S1 a one meter square pit was excavated to a depth of 5Ø centimeters by arbitrary 1Ø centimeter units and by natural stratigraphic units, when encountered. The placement of the pit in the southwest corner of the structure was chosen because of proximity to the walls, fireplace, and the relative shallowness of the overburden from wall collapse and slope wash. Excavation revealed an intact floor about one meter below the surface. Recognition of the floor was made especially easy by an in situ rug. S13 was selected for test excavation because of its location along the former road, building material type, possible Mexican occupation, and the relatively little damage to standing walls. A one meter square pit was excavated to a depth of 1.15 meters below the surface in the northeast corner of the structure through a berm formed from a collapsed wall. A charcoal rich layer about Ø.45 meter below the surface represents the structure's last occupation. Earlier floors, unfortunately, could not be discerned stratigraphically or artifactually. The test pit in S18 was begun after it became apparent that the deposits of S2Ø were either disturbed or not from the interior of the building. However, the artifact content of the structures contrasted strongly, and a functional difference was suggested. The one meter square test pit was extended down about Ø.9Ø meter and revealed no distinct floor surface. Finally, a one meter square test pit was excavated to a depth of 5Ø centimeters in the presumed southwest corner of S2Ø. This stonewalled structure revealed a wealth of Chinese artifacts, as did S18, but little in the way of discrete living surfaces. Stratigraphy was preserved but appeared to represent a myriad of depositional episodes with little resemblance to occupational floors. It is our belief that these deposits are either outside the structure or are disturbed.

Artifacts

The artifacts collected from Shoshone Wells during the 1981 field season came from the surface in and around S1, S13, S18, and S2Ø; from test excavations in each of these structures; and from several trash scatters. Each artifact was accessioned into the UNR Anthropology Musem. For purposes of analysis, the use of artifacts was identified, whenever possible, and the collection was then classified into functional categories using the system proposed by South(1977). Here, artifacts used in the same general kind of activity are put into the same group. The artifact groups defined at Shoshone Wells are culinary, furnishings, construction, personal, and animal husbandry. Those artifacts that could not be identified have been placed into an "unidentified" group. The group is then further classified into classes. Each class is a more specific functional category; thus, the personal group includes clothing, the opium complex, gaming, music, and firearm classes. Finally, both functional and stylistic criteria have been used to classify artifact classes into types. In the tableware class at Shoshone Wells, for example, are such stylisic and technological types as Chinese brownware or jian you, swatow, four seasons, celadon, and ironstone.

The artifact classifications are shown in Tables 2 through 5. Artifacts from each of the collections are tabulated by stratigraphic level, in the case of test excavation units in the four structures, or by geographical location, as in the case of trash scatters. In this preliminary report, no attempt has been made to fully define and describe each of the artifact categories identified in the collections. All of the categories have, in fact, been defined and described in several other reports; previously unreported variants will be more fully described after the second field season has been completed, if they have been found to exist.

1. Structure 1. Table 2 tabulates artifacts collected from this hillside building. The artifacts appear to be rather typical of Euroamerican households dating to the turn of the 20th Century. And there is no evidence of significant differences among artifacts coming from different stratigraphic units. For that reason, the collection is treated here as a single unit. The construction group and the unidentified classes of wood, glass, and bone fragments dominate artifacts from structure 1. Wire nails and cut nails occur in about equal proportions; although a nail chronology is far from being established in the American West, these proportions are consistent with a turn of the century date. The next largest number of artifacts originate in a variety of domestic activities. Culinary activities are evidenced by lard pails, an MJB coffee can, a log cabin syrup can that has been converted into what appears to be an oil lamp(Figure 15), pine nut shells, and egg shells. Surprisingly, tableware is virtually absent. Other domestic activities are suggested by the recovery of lamp chimney fragments, a glass lamp base, a brass key, mirror fragments, and kerosene can fragments. The personal group is also well represented. Most of the personal artifacts have been put into the clothing class and include a variety of artifacts that must have come from men's boots, shoes, gloves, shirts, and trousers; however, what appears to be a fastener from a bra strap suggests the presence of women. That interpretation is also supported by the mirror fragments, mentioned above. Finally, structure 1 is unique among the excavated buildings at Shoshone Wells in having a lot of archaeological evidence of the use of firearms, perhaps indicative of hunting for wild game.

2. Structure 13. Artifacts recovered from this adobe building in the linear cluster are also dominated by the construction group and by unidentified glass, wood, and bone fragments(Table 3). Nails in the collection are mostly cut, suggesting a somewhat earlier date than structure 1. Wire nails do, however, occur, although in small quantities; for that reason, it is unlikely that the occupation of structure 13 can be pushed back beyond the 1890s. The culinary group is here, as in structure 1, the second most common artifact category. Tableware, however, is the

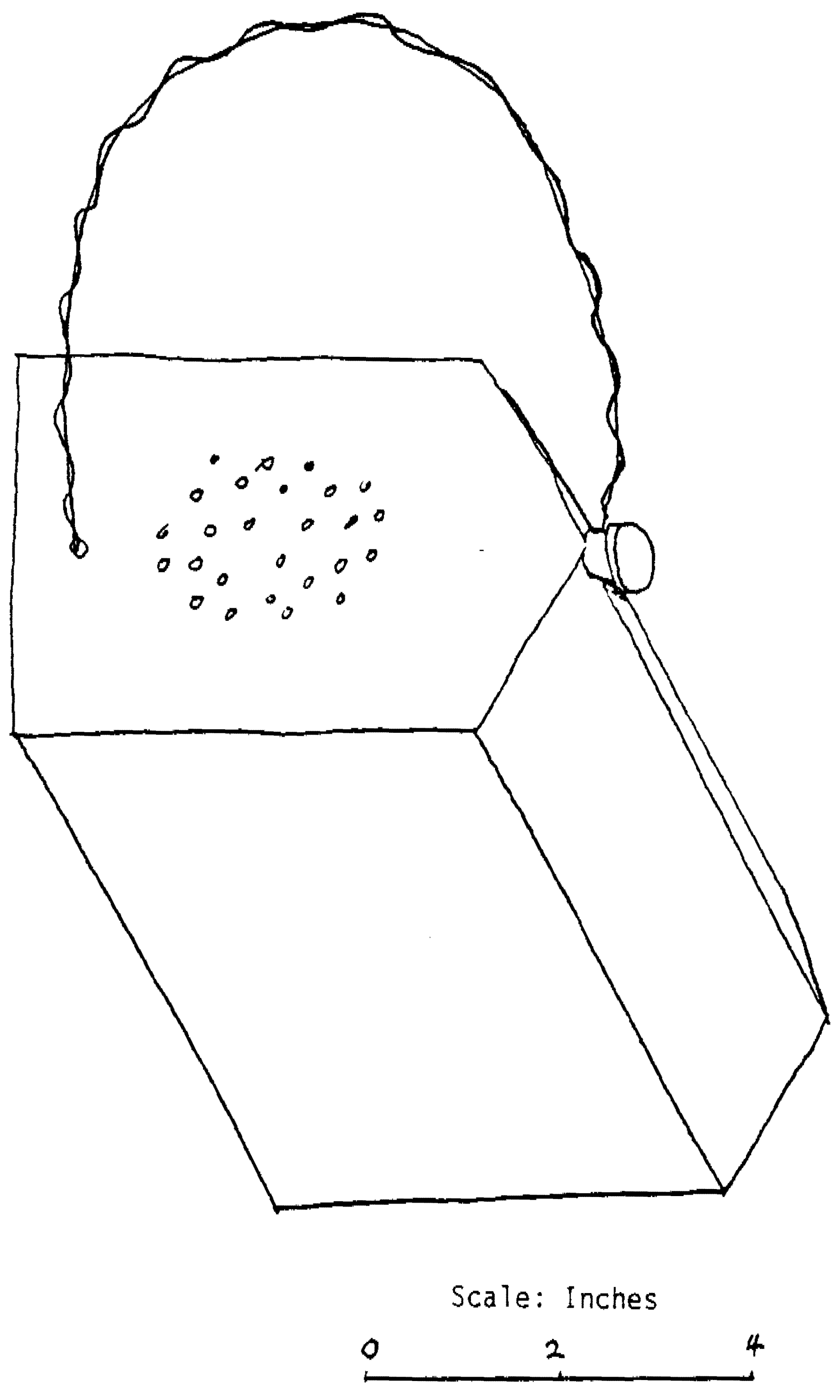
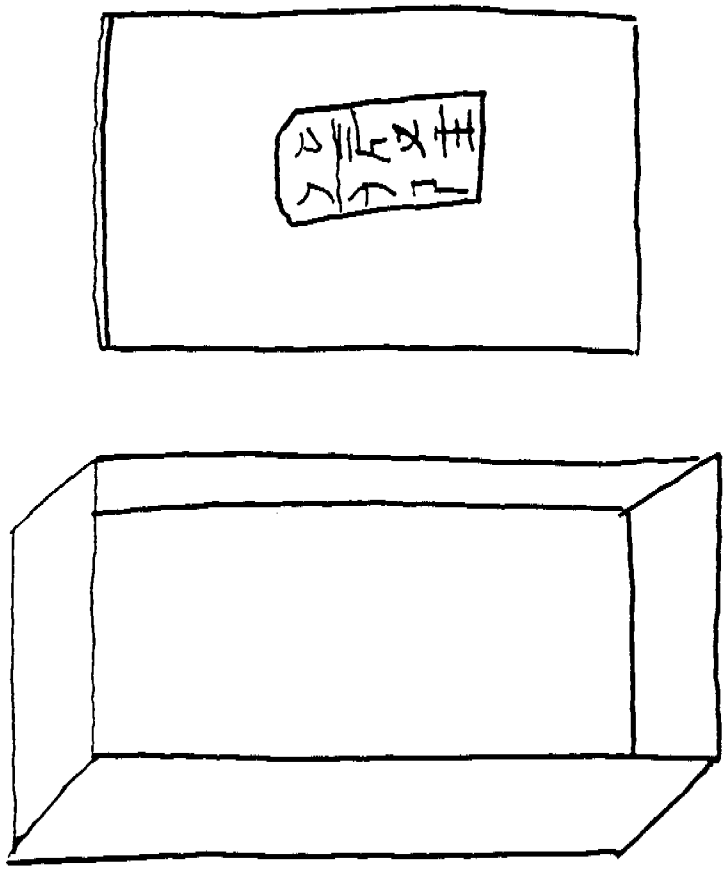


FIGURE 15. A "LOG CABIN SYRUP" LAMP FROM SHOSHONE WELLS

most abundant class and western food containers such as cans are virtually absent. The tableware is mostly jian you and a few other Chinese import types, suggesting a Chinese occupation for the structure sometime in its history. Perhaps the most interesting artifact in the tableware class, however, is a single fragment of tin-glazed earthenware that may be majolica; if so, a Mexican presence is also suggested. Fragments of lamp chimneys and kerosene cans indicate the same kind of household furnishings as in structure 1, a similarity that also extends to structures 18 and 2Ø. And several pieces of cast iron stove show how the structure was heated. The presence of iron stoves is unusual in early frontier households, or at least that appears to be the case, so that the relatively late date for the structure is given further support. Clothing is the only personal activity suggested by the artifacts from structure 13. The class includes a large piece of rubber boot with a canvas top, an item represented by small fragments throughout the settlement of Shoshone Wells. There is no direct archaeological evidence of the use of firearms, but several lead fragments may be waste from bullet manufacturing. Finally, use of animals by the structure's occupants is indicated by what is probably a donkey or pony shoe, a harness fragment, and a horseshoe nail. Archaeological evidence of similar activities occur at all of the structures except for structure 1.

3. Structures 18 and 2Ø. The Chinese settlement at Shoshone Wells is most visible archaeologically in the building cluster around the depression or walk-in well adjacent to the stream. Both structures 18 and 2Ø are in that cluster, and artifacts recovered from them add further support to such an interpretation. Tables 4 and 5 show the artifacts from the two collections. In both structures the construction group and unidentifiable wood, glass, and bone fragments dominate the artifacts. There is, however, a clear difference between the structures in the relative proportion of cut and wire nails, suggesting different periods of occupation. Not only does structure 2Ø have no wire nails but also it has several wrought nails; an occupation that predates the 189Øs is indicated. By contrast, structure 18 includes a few wire nails, although cut nails are still the most common by far. An 189Øs date is suggested. As in the other tested structures, both structures 18 and 2Ø have artifacts originating in domestic activities as the second most common category and as in structure 13 the tableware class is made up nearly exclusively of Chinese import types. Of the latter, jian you, mostly used as food containers such as soy sauce pots, is the most common at both places. There is, however, a significant difference in the relative occurrence of decorated import wares: structure 18 has nothing other than swatow, while the other structure has four seasons, celadon, and swatow wares. Much of the bone recovered from both places appears to be domestic pig, although no formal analysis has yet been done. Other foods suggested by the archaeological record include peaches, eggs, pine nuts, and canned fruit or vegetables. Heating and lighting in the two buildings were apparently the same as elsewhere at Shoshone Wells: lamp chimney fragments, kerosene can fragments, and cast iron stove parts were recovered. Personal group artifacts from the two structures are distinctively Chinese, with the exception of the clothing class. Chinese gaming pieces were located in both structures, and the collection from structure 2Ø includes a nearly complete opium box(Figure 16), an opium pipe bowl fragment, a Chinese coin with a square centerhole that has yet to be identified more precisely, and what may be a piece of burnt incense. Evidence of firearms occurs at both structures, as does the use of domestic animals. Structure 18 includes archaeological evidence of blacksmithing,



Scale: Actual Size

FIGURE 16. AN OPIUM BOX FROM SHOSHONE WELLS

including slag and a large number of horsehoe nails. In addition, bifaces and several chert flakes came from the same structure. All in all, the artifacts from structure 18 suggest multiple occupations, although there is no direct stratigraphic evidence for such an interpretation.

4. Trash Scatters. Seven trash concentrations were recorded within the study area. The two major concentrations are T2 and T4, which were sampled. Another series of four small trash piles(T3, T5-T7), made up mostly of broken bottle glass, was located in the southwest corner of the site. Although none of these areas were excavated, and although they undoubtedly have been collected by vandals, they provide high information content per person hour.

T1. This trash scatter is situated between structures 1 and 2 on the hillside above the main site area at Shoshone Wells. A variety of household items and food and drink containers are included. The scatter dates from about 1900 to the late 1920s. A glass wine bottle seal stamped "Milano" was recovered from this locality.

T2. On the western edge of the north-south road through the site is a linear trash concentration about 50 meters long. Although much of this trash lay in the roadbed, it appears to have been discarded originally between the road and the adjacent structures(S11 to S15). This concentration has a dark charcoal/organic stain but few artifacts are burned. The time range, as reflected in nail chronology, appears to be long, possibly extending from the 1860s well into the 20th Century. L-head forged nails, cut nails, and wire nails were all recovered. Other time sensitive artifacts such as Euroamerican earthenware and glass bottles were present but were recovered in such small pieces that no dating of artifacts was possible. A mule shoe, forged metal strapping, horse/mule shoe nails, and cast iron stove fragments were recovered also. Chinese artifacts include small storage pots or jars, bowl fragments of three principal ceramic types, brass container fragments, and opium pipe fragments.

T3. The dating of this rather dense bottle concentration is slightly confused by two conflicting dates two years apart. An age assessment of ca. 1887, however, is probably accurate.

T4. This trash scatter is on the west bank of the drainage running north to south through the site. It is mostly composed of Chinese artifacts, although some Euroamerican bottle glass, earthenware, and cast iron stove parts were noted also. Of particular interest are the rim and body fragments of at least three large earthenware shipping jars, probably once about 0.75 meter in diameter. Other debris includes bowls of the three principal ceramic types, brass container fragments, pig bones, and unidentified large mammal bones. T4 contrasts with T2 in the relatively greater proportions of Chinese artifacts and butchered bone. In addition, it lacks forged metal artifacts and the large number of nails recovered in T2.

T5. This is one of the four broken bottle concentrations in the southwestern corner of the site. The dating of the liquor bottles from the trash indicates deposition about 1888.

T6. Only one diagnostic maker's mark, dating between 1880 and 1890, could be recognized in this broken bottle scatter.

T7. Although numerous bottle bases were recorded at this locus, only two identifiable maker's marks were found. These suggest deposition between 1881 and 1900.

Table 6 lists all of the maker's marks that could be identified in the trash scatters at Shoshone Wells.

THE HAUL ROAD PROJECT

In addition to the management strategy and the excavations at Shoshone Wells, the 1981 phase of the Cortez project also included evaluation and mitigation of impacts upon cultural resources in the right-of-way of a proposed haul road through the district. That work, however, was not part of the original Scope of Work stipulated in the BLM contract; it was done at the request of the Battle Mountain district office. The right-of-way was surveyed with the district archaeologist. Agreement was reached that the only significant impacts would be upon the lime kiln at Wenban's mill, the tramway connecting the Garrison mine and Wenban's mill, an industrial trash scatter at the edge of the tailings flow from the Consolidated Cortez mill, and upon the tailings flow itself. Figure 17 shows the location of these features. Avoidance was the principal mitigation recommended; however, mitigation also included mapping of the structures and trash scatters, test excavation of the tramway grade to identify its construction, and the recovery of a "type collection" from the features.

The lime kiln is shown in Figure 4, along with several associated features. Perhaps the most impressive is a large deposit of ash and charcoal flowing from the vicinity of the kiln's mouth down an embankment. Several wooden barrels filled with lime are situated in a gulley in the midst of the ash/charcoal deposit(Figure 18). At the base of the ash/charcoal deposit is a tramway grade and further down the embankment from that grade is a second tramway grade.

Figure 19 illustrates the industrial trash scatter. The scatter is made up of three distinct activity loci. Cupels, slag, and such domestic trash as liquor bottles and food cans are found in the largest locus and suggest assaying activities from the Consolidated Cortez mill. On the northeastern edge of the assaying locus is a pit and associated rock pile, which, after excavation and an interview with a mining engineer, was determined to be a prospect probably dug about 1965. And, finally, to the southwest of the assaying locus is a dense scatter of cyanide can lids, probably also associated with the Consolidated Cortez mill.

The tramway grade was cross-sectioned at a point just above the lime kiln. Information obtained from that excavation suggests that the grade was constructed by cutting into the hillside and that nothing else was done to modify the natural terrain. For the most part, portable artifacts are not associated with the grade; however, pinyon pine ties with railroad spikes remaining are visible in a few places along the grade.

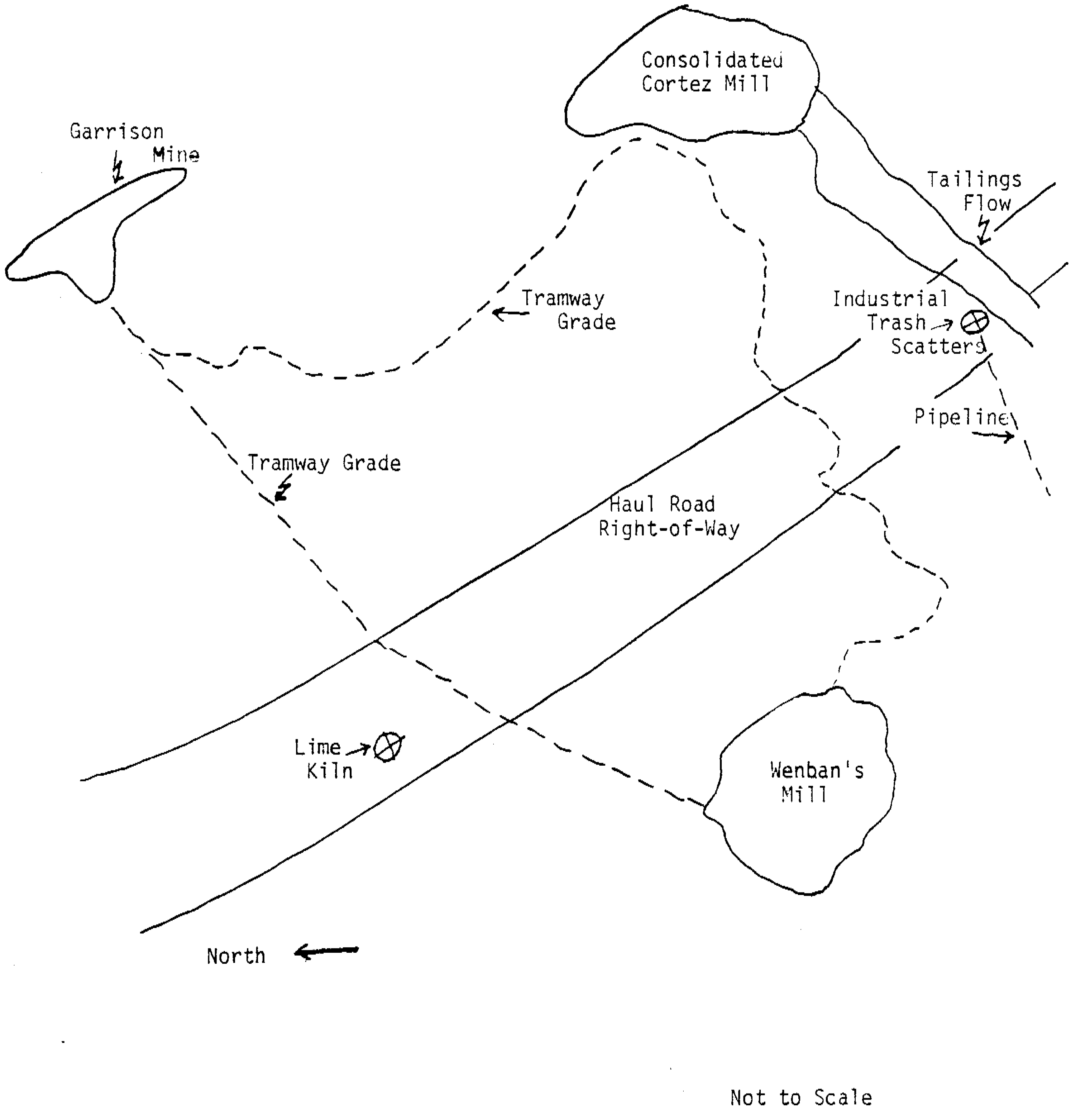


FIGURE 17. LOCATION OF FEATURES IN HAUL ROAD

Figure 18: Barrels of Lime near the Lime Kiln at Wenban's Mill.

Figure 19: Cyanide Can Lids near the Consolidated Cortez Mill.

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TABLE 1

1900 CENSUS DATA FOR THE CORTEZ DISTRICT

Voting Precinct	WHITE Native	WHITE Italy	WHITE Mexico	WHITE Other	CHINESE China	CHINESE Native	BLACK	INDIA
Cortez	43(15)*	11(3)	8(2)	9(2)	33(5)	1(1)	10(5)	1(1)
Garrison	72(24)	12(1)	2(1)	21(4)	47(0)	1(1)	3(3)	0
Total	115(39)	23(4)	10(3)	30(6)	80(5)	2(2)	13(8)	1(1)

* Figures Shown in Parentheses are Number of Females in Total

TABLE 2

CLASSIFICATION OF STRUCTURE 1 ARTIFACTS

Group	Class	Type	Surf.	L1	L2	L3	L4	L5	Total
Culinary	Tableware	Celadon	1			1			2
	Containers	Lard pails	2						2
		Crimped cans	2						2
		Ceramic bottles			1				1
		MJB Coffee cans	1						1
		Log cabin syrup can	1						1
		Kerosene cans	12						12
	Prepar.	Metates	1						1
Furnishing	Lamps	Chimneys		3	1	2			6
		Base, glass		1					1
	Mirrors	Mirrors					2	2	4
	Other	Keys, brass				1			1
		Brass plug				1			1
Construct.	Nails	Cut	2	27	16	32	24	1	102
		Wire		25	8	28	29		90
		Unidentifiable		8		4		4	16
		Wrought					1	1	2
	Windows	Glass	5	1		2			8
	Screws	Wood		1	1				2
	Tacks	Tacks		3			3		6
	Washers	Washers, brass		1		2	1		4
	Roofing	Tarpaper				1			1
Personal	Clothing	eye from bra strap				1	1		2
		Canvas/rubber boot	1		20	4			25
		Buttons	1						1
		Fabric		1		4	5	2	12
		Rivets,trouser	1			1	1		3
		Shoe fragments	12						12
		Glove fragments	1						1
	Firearms	Peters Cart., .16				1			1
		Repeat.Cart., .16		1	1				2
		Reming.Cart.,.410			1		1		2
Unknown	Glass	Green	1				2		3
		Turquoise		5	2	2	1	1	11
		Clear	3	8	5	5	11		32
		Amber	2	4	3	4	11		24
		Purple		3					3
	Metal	Wire	1	2	2	3			8
		Unident. frags	1	14	14	30	16	4	79
	Bone	Fragments	2	48	13	60	31	6	160
	Wood	Fragments	3	11	142	128	62	14	360
	Lithics	Chert flake	1						1
	Other	Red lead paint	1						1
		Lead foil			2		1		3
		Eggshell				4			4
		Pinyon pine nut shell		1	2				3
		Plastic				2			2

TABLE 3

CLASSIFICATION OF STRUCTURE 13 ARTIFACTS

Group	Class	Type	Surf.	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	Slump	Tot.
Culinary	Tableware	Jian you	1					1	12	3					17
		Celadon												2	2
		Four seasons							2					4	6
		Grey incised							1						1
		Ironstone	3						2					1	6
		Majolica							1						1
		Polychrome stoneware								1					1
		Unglazed redware	1						1						2
Furnish.	Lamps	Chimneys												1	1
	Stoves	Iron					4								4
	Fuel	Kerosene cans	1							2					3
Constr.	Nails	Cut	1				1			1				27	30
		Wire					1							3	4
		Unidentifiable							2	20				37	59
	Spikes	Fragments								1					1
	Screws	Wood												1	1
	Tacks	Fragments								1					1
	Bricks	Fragments							2			1			3
	Plaster	Fragments			1	1					2		1	4	9
	Bolts	Eye							1						1
Personal	Clothing	Buttons												2	2
		Glove fragments						3							3
		Canvas/rubber boots						1							1
		Fabric fragments						3			5			2	10
	Opium	Pipe bowl frag.												1	1
Animal	Maintenance	Horseshoes							1						1
		Horseshoe nails								1					1
	Tack	Harness						1							1
Unkown	Glass	Aqua												1	1
		Green												1	1
		Amber	1												1
		Clear					1		12	7	2				33
		Black								3				2	5
		Turquoise								1				2	3
	Lithics	Chert flakes			1					2	2			1	6
	Wood	Fragments					2		1	10		1	1	10	25
	Bone	Fragments							4	45			2	7	58
	Leather	Fragments							1	1					2
	Metal	Fragments							1	2				8	11
	Other	Lead foil								2					2
		Lead fragments							1	5	2			1	9

TABLE 4

CLASSIFICATION OF STRUCTURE 18 ARTIFACTS

Group	Class	Type	Surf.	L1	L2	L3	L4	L5	L6	L7	L8	L9	Unprov.	Total
Culinary	Tableware	Jian you		1			1	1	4	2	12	8	1	30
		Swatow	1		1	1				2	1	1		7
		Porcelain.						1				1		2
	Containers	Can, hole-in-top	3					1						4
Furnish.	Lamps	Chimneys		1										1
	Drawer knob	Porcelain											1	1
	Mirrors	Fragment					1							1
	Fuel	Kerosene cans	3											3
	Other	Milk glass									1			1
		Brass lid	1											1
Construct.	Nails	Cut			5	1	9	70	41	10	19	13	12	180
		Wire						1	2	1	1		1	6
		Wrought								1	1			2
		Unidentifiable							2	3	10	8	3	26
	Tacks	Tacks										2		2
	Spikes	Spikes										1		1
	Windows	Glass			2	1	5	65	41					114
	Tools	Files								1				1
	Blacksmith.	Slag								2		5		7
	Washers	Brass									1			1
	Hinge	Hinge										1		1
Personal	Clothing	Buttons								1	1	1		3
	Opium	Pipe stem, brass				1								1
	Gaming	Chinese marker				1								1
	Firearms	Cartridge, .22								1				1
Animal	Mainten.	Horseshoe nails				1			6	5	22	9	2	45
Unknown	Glass	Turquoise								10				10
		Clear		7	2	2					15	9	13	48
		Amber	1					1	3				1	6
		Black		1				1	1			3		6
		Yellow								1				1
		Green								1	27	20	1	49
	Wood	Fragments		1		1	2	2	3	1	2	3	1	16
	Leather	Fragments	4									1		5
	Bone	Fragments		1				1		2	22	4	1	31
	Lithics	Bifaces			1						1			2
		Chert flakes		3	1	5	2	4		2	4	8	3	32
	Metal	Wire	2					1		6				9
		Unknown	1			1	2	1	10	10	3	2	1	31
	Other	Lead frags						1						1

TABLE 5

CLASSIFICATION OF STRUCTURE 20 ARTIFACTS

Group	Class	Type	Surf.	L2	L3	L4	L5	L6	Unprov.	Total
Culinary	Tableware	Jian you	4	14	7	1	3		11	40
		Four seasons	4		21				5	30
		Swatow	4	2	5	1	1		1	14
		Celadon	1						1	2
		Grey, incised			1					1
		Yellow glazed	1							1
	Containers	Ceramic bottles	1							1
		Cans, hole-in-top	2		2	1				5
	Refuse	Domestic pig				6			2	8
		Peach pits	2							2
		Pinenut shells		1					3	4
Furnish.	Stoves	Cast iron parts	1							1
Construct.	Nails	Cut	14	61	85	11	14	11	22	218
		Wire					1			1
		Wrought			17					17
	Washers	Brass				1				1
	Windows	Glass	1		16				1	18
	Roofing	Metal sheets	5							5
		Wood shingles	3							3
	Plaster	Fragments	1		4			1	1	7
Personal	Clothing	Suspenders		1						1
		Canvas/rubber boots			1					1
	Opium	Tins	9	1	1	2				13
		Pipe bowl	1							1
		Incense(?)		1						1
	Gaming	Chinese marker			1					1
	Firearms	Cartr.,.32 "H"							1	1
		Cartr.,.410	1							1
		Cartr..44UMC	1		1					2
	Other	Harmonica	1							1
Animal	Mainten.	Horseshoe nail							1	1
		Curry combs	1							1
Unknown	Glass	Purple			6			1	2	9
		Green	7	4	4	1		14	1	31
		Clear	19	28	23	5	7	24	20	126
		Black	2	1	3		1		1	8
		Amber	2		3				3	8
		Turquoise		1	8		1	1	2	13
	Metal	Wire	1	2						3
		Unknown frags	31	2	22	1	2	8	2	68
	Bone	Fragments	19	11	27	10	17	35	5	124
	Leather	Fragments	1		3			1		5
	Wood	Fragments	7	1	24	4	2	3	4	45
	Lithics	Chert flakes					1		2	3
	Other	Lead foil		1	3				2	6
		Cork	1							1

TABLE 6

MAKER'S MARKS FOR TRASH CONCENTRATIONS

T-1

NB (North British Bottle Manufacturing Company) 1903-1937
PCGW (Pacific Coast Glass Works) 1902-1929
WF&S (William Franzen and Son) 1900-1929

T-3

CCG (Cream City Glass Company) 1888-1894
DOC (D.O. Cunningham Glass Company) 1888-1937
SB&G Co. (Streator Bottle and Glass Company) 1881-1905
R&Co. (Roth and Company ??) 1879-1888
MGW ca. 1889
C&Colim(Unknown)
Wis Glass Co. (Wisconsin Glass Company) 1882-1886

T-5

R&Co. (see above) 1879-1888
DOC (see above) 1888-1937
FB&Co (unknown)
CCGCo. (Cream City Glass Company) 1888-1894
SB&GCo. (see above) 1881-1905

T-6

FHGW (Fredrick Hampton Glass Works) 1880-1900

T-7

FHGW (see above) 1880-1900
SB&GCo. (see above) 1881-1905
"1874" (unknown)