The lonely, long-abandoned Yale Cabin dates from the early years of the century. It is now located in Gates of the Artic National Park and Preserve. Photo by Jet Lowe, NPS.

many of Alaska's park visitors—and in many instances National Park Service decision-makers as well—to believe that cultural resources in Alaska's parks are relatively unimportant.

In order to educate the public and park staff about this rich cultural heritage, cultural resource professionals in recent years have compiled an impressive list of archeological overviews, historic resource studies, and similar documents that have pinpointed the importance and scope of archeological and historical values that exist within Alaska's parks. While important, these publications have been distributed to a relatively small and specialized audience of park managers and cultural resource professionals.

In order to broaden public knowledge about the gold rush-era in Alaska's parks, the region's Cultural Resources Advisory Committee decided in early 1997 to publish a pamphlet series that spotlights the century-old mining activities in six of Alaska's national park units. The text and graphics for the "gold rush centennial brochures" were produced by the various park cultural resource specialists. The brochures were distributed to the parks to be used at their discretion.

The brochures, which are available to Alaska's park visitors, should play a key role in

educating the public about the history of gold mining in Alaska's national parks. These new publications should also help visitors understand that Alaska's parks offer exciting history as well as outstanding scenic and wildlife values.

Frank Norris is a historian at the Alaska Support Office in Anchorage. During the 1980s, he spent several years at Klondike Gold Rush NHP in Skagway. He is the author of an administrative history of the park, and the co-author (with David Neufeld of Parks Canada) of Chilkoot Trail, Heritage Route to the Klondike*, published by Lost Moose Press of Whitehorse in 1996.*

Greg A. Brick, Robert M. Thorson, and David A. Poirier

Geoarcheology of the Jinny Hill Mines

Traditional geological methods such as petrography, field mapping, sediment coring, and particle-size analysis, were used to investigate the Jinny Hill mines, a 19th-century industrial archeological site at Cheshire, Connecticut. The Jinny Hill mines were the first barite mines in the United States, and the deepest (600 feet) and most extensive vein mines (four miles of passages) in Connecticut. Despite the impressive scale of the historic mining operations, many landowners were unaware of its former existence. These superlatives also contrast oddly with the near invisibility of the mines today, providing a case study in the ephemerality of this industrial landscape.

Barite, also known historically as barytes, heavy spar, tiff, and cawk, is barium sulfate. Derived from the Greek word for heavy, barite is one of the heaviest nonmetallic minerals with a specific gravity of 4.5. It is most often white in color, soft (3 on the Mohs scale), has three cleavages, and is relatively inert. Barite was discovered in Cheshire about 1813 and was mined there from 1838 to 1878. The Cheshire barite district was comprised of the Jinny Hill mines and the smaller, short-lived Peck Mountain mines. The total production of 160,000 tons came mainly from Jinny Hill. From Cheshire, barite was transported to New Haven via the now-defunct Farmington Canal where it was milled, affording the sole American supply (during the early years of the operation) for use in the manufacture of white paint.

The climax of mining activity came shortly after the Civil War, when several companies mined the deposits simultaneously. The majority of the miners were Cornish immigrants who had come to this country specifically to work underground. Eventually it became uneconomical to mine the deposits.

No field investigations of the historic Jinny Hill mines occurred before Crawford E. Fritts, employed by the United States Geological Survey in the late 1950s, mapped the bedrock geology of the Mount Carmel quadrangle. Fritts identified three parallel veins of barite, historically known as the north, central, and south veins. The locations of then-observable mine entrances (shafts and adits), mine dumps, and prospect pits were noted. Today, one is challenged even to locate the mines, so effectively have natural processes and residential development obliterated their surficial indications. This situation has created potential safety concerns with town officials and neighborhood residents. These concerns were explicitly addressed by the on-site research of the Department of Geology and Geophysics at the University of Connecticut.

Rediscovering the Jinny Hill Mining Complex

Mid-19th-century accounts provide the earliest written record of underground barite mining at Jinny Hill, at which time the mines were 200 feet deep. A decade later, firsthand descriptions of the underground workings noted that its 400 foot depth was accessed by two distinct shafts. An 1892 reference indicates the presence of Cornish miners at Jinny Hill.

The Jinny Hill mines achieved a final depth of 600 feet with half a dozen shafts when abandoned, a modest accomplishment by Cornish mining standards. By 1938, the overgrown mine dumps at Jinny Hill had become a locally-known mineral-collecting locality.

Annual reports, company records, and contemporary accounts have not been found despite Brick's extensive archival research. Furthermore, local newspapers did not began publication in Cheshire until after mining had ceased. Thus, geoarcheology became an important source of information for understanding the history and technology of the Jinny Hill barite mine.

Clues from a Remnant Landscape

Neither vertical (shafts) nor horizontal (adits) mine entrances were observable. In addition, no mill or other structural foundations were observable. Surficial evidence suggests that the Jinny Hill barite mining operation were generally "low tech" in comparison with contemporary mining sites.

Mining operations were physically represented through the existence of sinkholes, that is, surface depressions which exhibit downward collapse, i.e., the ability to "swallow" objects over an interval of time. In order for collapse to occur, there must be an open mine void below; sinkholes are thereby distinguishable from prospect pits, which are bedrock-floored. Based upon interviews with landowners, the majority of sinkholes at Jinny Hill represented shafts, although some appear to represent collapsed mine passages.

Lines of sinkholes were mapped in the field, confirming the linear geometry and depth of the Jinny Hill ore deposit. The largest sinkhole at Jinny Hill, about 10 meters across, marks the location of

Surviving ox-cart road for transporting barite from the Jinny Hill mines to milling operations in New Haven.

the middle shaft of the central vein. The current property owner indicated that many years ago this shaft was open and later was filled with trees felled by the 1938 hurricane. This former sinkhole presently contains extensive landscaping debris.

The south vein shaft is represented by a sinkhole about four meters across. Local residents remembered dropping pebbles down this shaft, which was open at that time, waiting to hear them splash in water at the bottom of the shaft, seconds later. The shaft was filled in the 1960s when a bulldozer pushed tree stumps into it. In 1973 after heavy rains, the sinkhole opened to a depth of fifteen feet and necessitated further filling.

There is also a shaft into the north vein, represented by a sinkhole about four meters across. The landowner noted that the Town of Cheshire brought in fill, but the hole reappeared. Interestingly, this may have been the shaft referred to in an 1850 account of a minor cave in, which trapped miners underground for an entire day. Road construction in the Jinny Hill area has occasionally exposed adits or mine-related structures.

An attempt was made to reconstruct the transport system of the Jinny Hill mining era, i.e., the ox-cart routes used by the miners for transporting barite from the mines to the canal or railroad, by mapping unimproved roads that contained barite fragments in the road bed. Possible road beds were examined by trenching across the width of the road with a shovel. The most visible artificial landscape feature created by mining is an unimproved road, about 800 meters long and two meters wide, located in vicinity of the central vein. Runoff has gullied the road in several places revealing barite fragments in the road bed. The eastern half is impassable to vehicles, but is clearly delimited by mature trees to either side. This road crosses a wetland on a causeway of rock waste and then dwindles to a footpath. Shorter fragments of additional unimproved roads that appear linked to the mining operations were also identified throughout the Jinny Hill neighborhood.

The locations of mine dumps or tailing heaps were identified and mapped. Although seven mine dumps had been observed in the 1950s, only three were relocated. Local residents indicated that the tailing piles had been subsequently "mined" as readily obtainable fill for road improvements or house foundations. In contrast to the once-extensive mine dumps, small isolated mounds of mine tailings survive throughout the Jinny Hill area. In the hope of locating mine-related artifacts, the mine dumps were swept with a portable magnetometer. A lime-encrusted boiler fragment, possibly part of a steam engine for raising ore or dewatering the mine, was discovered within the mine dump associated with the central vein.

Anthracite coal was found scattered throughout the mine dumps. Importantly, coal fragments were found in the Parker wetland where they were associated with barite particles indicating contemporaneity. The coal is tentatively interpreted as fuel for the mine's steam engines.

Several mine-related features were conspicuous by their absence. No shot-holes, whether machine or hand-drilled, were found on outcrops or rock waste at Jinny Hill, even though it is likely that explosives were used for the deadwork (passages through barren country rock, providing access to the ore deposit itself). Although streams were sometimes dammed to store water for dressing ores, no hydraulic workings were found. Despite extensive field studies, little new information was obtained regarding the technology of mining within the Jinny Hill district; such data await more intensive geological and archeological investigations.

The Barite Anomaly

Because the original volume of the barite deposit at Jinny Hill was insignificant relative to that of the surrounding rock matrix, barite has a low background concentration on the land surface at Jinny Hill. Thus, any feature associated with barite fragments has a high likelihood of being associated in some way with barite mining. Quite simply, concentrations of barite equate with evidence of the historic mining operations. The boundary between an area containing the distinctive white barite fragments and that which did not became the most significant heterogeneity in the field.

Based upon a previous discovery of barite silt in a wetland downstream from the Jinny Hill mines, Thorson predicted that wetlands downstream from the Jinny Hill mines would exhibit a distinct, barite-rich interval, formed as a result of a pulse of mine sediment passing through the fluvial system during the mining era. Three wetlands likely to have retained mine sediment were selected for sampling in the vicinity of the south vein dump. These wetlands were, from north to south, the Parker wetland, the Clouse wetland, and Fresh Meadows Wildlife Sanctuary. Expectations were that these wetlands might provide a vertical, temporal sequence to complement the horizontal, spatial dimension of the barite distribution provided through the mapping of mine-related features.

Examination of wetland stratigraphy included excavation of a soil pit in the Parker wetland, a red maple swamp, located immediately downstream from the south vein. This led to the discovery of a brilliant white layer of barite sediment, 5 to 20 centimeters thick, that was located beneath 20 centimeters of topsoil. Below the barite horizon were alternating layers of arkosic sand and silt which were located above a wood-rich organic paleosol.

The stratigraphy of the Parker wetland was interpreted as a fluvaquent overlying a buried paleosol. Presumably the paleosol predates European settlement, while the fluvaquent resulted from post-settlement land use practices, such as deforestation. The barite horizon, representing the mining era, was depicted as a single, well-defined C horizon in the soil profile.

Through soil augering, the barite layer was found to underlie most of the Parker and Clouse wetlands and was traced upstream from the Parker wetland to the south vein dump. Conservatively estimated from planimetric measurements on the Town of Cheshire's topographic survey, the barite layer underlies about three acres of wetlands. Estimating the average thickness of the layer to be 20 centimeters, it's calculated that there are about 2,500 cubic meters of barite sediments downstream from the south vein.

To determine which size-fraction barite had been water-transported from the mines to the wetlands, a sample from the Parker wetland barite horizon was wet-sieved. In larger mesh sizes, barite particles are readily distinguished from reddish (iron-stained) grains such as, quartz and feldspar, by their distinctive white color. When examined under a petrographic microscope, barite particles are distinguished from other particles by the exhibition of dispersion fringes (also known as Becke lines), lack of relief, and cleavage pattern.

Barite particles from the Parker wetland barite horizon fell into the fine sand and silt fractions (Unified Soil Classification). Most petrographic views of smear mounts of material taken directly from this layer contained 100% barite particles. Occasionally, particles of anthracite coal were encountered.

Having determined that barite had been transported in the silt fraction, samples from soil horizons above and below the Parker Wetland barite horizon were gathered and removed to the laboratory to be examined for the presence of barite silt. Standardized portions of each sample were wet-sieved to isolate the silt fraction from everything coarser. The silt was concentrated for barite using a gold pan. As a tool for heavy-mineral separation, panning has advantages over heavy-liquid separation techniques in terms of time and cost as well as the avoidance of toxic heavy liquids.

The pan was filled with water and the natant organic matter was decanted. Panning involved shaking the grains down to the angle of the pan and gently swirling the tilted pan. Barite particles appeared as a milky "flash" at the upper leading edge of pan concentrates, because the higher specific gravity of barite caused it to lag behind relative to the lighter, reddish grains. Petrographic methods were used to verify that the flash was indeed barite. No barite silt was detected below the white horizon, while only trace amounts were present above it.

The barite anomaly in the soils of Cheshire thus became an index of the historic mining activity. When mapped in space (horizontal) and time (stratigraphically), barite fragments were the key to reconstructing the mining site. The Jinny Hill mines were found to be a palimpsest of three successive operations: 1) copper prospecting, 2) underground barite mining, and 3) gravel quarrying. What was perceived as worthless in one phase, became a resource for the next. Most notably, the concentrated tailings from the barite mining became an economically important 20th-century gravel operation, which served to mask the prior presence of the barite mines.

Geoarcheological Reconstructions

A strong relationship exists between the geology of the barite ore deposit and the methods used to exploit it at Jinny Hill. The type of deposit suggested that underground mining would be required. In practical terms, mapping the Jinny Hill barite anomaly involved the identification of three kinds of features: mine dumps, mine roads, and wetlands downstream from the mines. Although the mine workings were inaccessible, field verification of mining shafts was accomplished by mapping lines of sinkholes. In addition, petrographic studies of rock outcrops revealed that no significant difference in mineralization existed; so the mine workings of the respective veins should be similar, all other things being equal.

The heaviness of barite and the brecciated character of the tailings suggested that to minimize freight charges miners dressed the ore near the mines. This was confirmed by coring wetlands downstream from the mines, where a layer of comminuted barite was found. The softness, cleavage pattern, and distinctive white color of barite suggest that field dressing the ore would not require anything more than hand methods, which was additionally inferred from the absence of mill foundations despite extensive field investigation. At Jinny Hill, where barite occurred in the interstices of a breccia, it would have been economical to remove as much of the valueless gangue (arkose) as possible to avoid paying freight charges to New Haven on waste rock. Hand picking and washing cannot account for the large volume of barite silt found in wetlands downstream from the Jinny Hill mines. Milling, which might otherwise have accounted for the fines, was carried out at New Haven. This suggested that a third, hitherto undocumented, form of dressing had been performed at Jinny Hill. It was simplest to assume that this involved the liberation of barite from gangue followed by the separation of the two. Specifically, this would have involved crushing the brecciated ore by cobbing (hammering), followed by hand picking to exclude the gangue. The distinctive white color of barite would have rendered it easy to distinguish from the reddish arkose.

Experimental studies conducted by Brick demonstrated that a simple dressing operation, crushing the brecciated ore by hammering, can generate abundant barite particles in the silt-fraction similar in size to those constituting the Parker wetland barite horizon. In terms of weight percentage, the amount of silt generated by Brick's experimental studies was less than 0.5 % of the weight of the specimens before cobbing.

The ore processing sequence was consistent with known documentary and field evidence. Ore was hand picked in the stopes by the miners. Unprofitable-looking pieces were used to backfill worked-out stopes, rather than being raised in the kibbles. The brecciated ore was cobbed at the surface to liberate barite from valueless gangue. A second round of hand picking separated sizable barite pieces from among fragments produced by cobbing. Barite pieces were washed in local streams to remove adherent dirt. Barite silt, inadvertently generated during cobbing, was borne away by the current and deposited in nearby wetlands.

In summary, geoarcheological field investigations and experimental material-processing studies undertaken by the University of Connecticut's Department of Geology and Geophysics provided important information on the Jinny Hill mines otherwise not available in the meager historical record for this early barite mining operation. Previously undocumented mine dumps, roads, shafts, adits, and artifacts exist at Jinny Hill and collectively, establish a coherent pattern of deep mining based on the Cornish system. Also, historic archeological features, alleged through local folklore to belong to the mining era, were proved not to be contemporaneous. Reconstructing the ore-processing flowsheet for the Jinny Hill mines revealed that three distinct dressing steps, cobbing (liberation), hand picking (separation), and washing (cleaning), are required to explain the extensive barite horizon in neighboring wetlands.

Hydrological changes and subsistence threats in underground mining districts is a well-documented and nearly intractable problem nationwide. On a smaller scale, the problem holds true for the Jenny Hill barite mining district in Cheshire. The University of Connecticut's geoarcheological investigations provided significant new information to the Town of Cheshire concerning potentially unstable mining-related areas which should guide future town-based planning decisions.

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Greg A. Brick received his M.S. degree in geology from the University of Connecticut based upon his studies of the Jinny Hill mines. After working for the U.S. Army Corps of Engineers in St. Louis, he became editor for the National Water Quality News.

Robert M. Thorson is Professor of Geology and Geophysics at the University of Connecticut. His research in New England involves the reconstruction of hidden historic impacts on the wetlands and watershed and how these changes influence contemporary landscape processes.

David A. Poirier is Staff Archaeologist and Environmental Review Coordinator for the Connecticut Historical Commission (State Historic Preservation Office). Dr. Poirier has previously co-edited thematic issues of CRM *that have focused on archeology and the public and on forensic archeology.*

Arthur B. Cohn

Cow Heads and Trout Farms

Underwater Exploration of the Dalliba-Lee Mine

It was late fall, and our nautical archeology fieldwork on Lake Champlain was completed. I was looking forward to a few quiet moments for research and writing. It was a routine day when an unusual telephone request came in from the town historian of Port Henry, New York. "One of our townspeople was in his flooded iron mine feeding his fish (he raises trout in the mine) and, as he was out on his dock, he looked down through the water and thought he saw an ore cart. We heard you might be able to help."

Indeed, the Lake Champlain Maritime Museum endeavors to assist regional agencies with the management of underwater cultural resources and I wanted to respond positively to Port Henry's request. Besides, the story was so intriguing. Having been a professional diver since 1974, I have been privileged to dive in many interesting places, but I had never explored a flooded iron mine. How to begin?

The mine was known as the Dalliba-Lee mine, named for its first and last operators. James Dalliba had established the first iron foundry in the community in the early 1820s, just after the opening of the Champlain Canal, which connected Lake Champlain and the Hudson River. In fact, Dalliba had been responsible for naming the town Port Henry after Henry Huntington, his wife's uncle and his benefactor. I told the town historian Joan Daby that the first step would be to come over and just see the mine. An on-site inspection would allow me to get a sense of the physical layout: the distance from the road, conditions which would affect actually getting equipment to the mine, staging issues for getting in and getting out, visibility and water temperature, and the relative stability of the structure. With this information, we would be