

b.

Prehistoric Turquoise Mining in the Southwest

Turquoise is a gemstone of rare, isolated occurrence, usually found in the form of small veins and stringers running through decomposed volcanic rocks. It gets its name, which means "Turkish" in French, from the fact that the original cut stones came into Europe from Persia through Turkey. The world-famous Persian deposits, worked since the early Middle Ages, occur in trachyte near Nishapur in the province of Khorasan. Centers for its mining in the New World include the Los Cerrillos Mountains, near Santa Fe (Santo Domingo Pueblo), the Superstition Mountains of Arizona, around Globe (Sleeping Beauty Mine), and lesser deposits in Nevada and California. The only mineral it resembles is chrysocolla, which is softer and usually more green and uniform in hue, typically lacking turquoise's prized coloration with small amounts of copper. In the New World it quickly surpassed jade and malachite as a sought-after gemstone. Pliny the Elder referred to the mineral as callais and the ancient Mexicans knew it as chalchihuitl ("green stone"), associating it with Quetzalcoatl. When the Chalchihuites Toltec site of Alta Vista in the Mexican state of Zacatecas was first explored by modern archeologists, evidence of more than 750 pre-Hispanic mines was discovered, together with turquoise from the American Southwest, nearly 1000 miles to the north. Turquoise from the north was imported in raw blocks and reworked here in special workshops. Later such workshops were introduced in Hohokam lands and finished goods were exported as far away as Yucatan. The following overview of American Southwest/Mexican Northwest mining was shared with me from the files of the Arizona Mining and Mineral Museum in Phoenix (closed in 2013). Katharine Bartlett, "Prehistoric Mining in the Southwest," Museum Notes (Museum of North Arizona, Flagstaff), vol. 7, no. 10 (April 1935), pp. 41-44.

Mining is a term not often associated with the prehistoric peoples of the Southwest. However, Pueblo folk had real mines where they obtained three sorts of minerals—turquoise, salt and coal.

This article attempts to sum up in a general way our present knowledge of these old mines and their locations. The mines in northern Arizona—at Mineral Park, Camp Verde, the Hopi villages—and the Los Cerrillos mines in New Mexico have been visited in person by the writer.

Turquoise Mines

In all of North America turquoise is found only in the southwestern United States. The prehistoric Pueblos were keenly aware of this mineral, wherever it occurred, and practically all turquoise deposits recently mined show evidence of having been worked centuries ago. It is hardly necessary to mention that turquoise ornaments were greatly valued by the ancient Southwesterners, who made exquisite turquoise mosaic inlays on bone, stone, shell and wood, and fine beads and pendants. Any community that had a turquoise deposit near at hand had an invaluable article for trade and no doubt were able to acquire by it all things that they needed. Turquoise trade was more than local too, for all the bits of this precious stone employed for inlaying masks and ornaments in Mexico are thought to have come from the

mines of the Pueblos.

Ancient turquoise mines are found in the following places: In New Mexico—At Los Cerrillos, Santa Fe County (this is the largest ancient or recent mine in the country and produced stones of great beauty and value, in shades of greenish-blue to fine sky-blue); in the Burro Mountains, and Little Hachita Mountains, adjacent to the Mimbres Valley, in Grant County; in the Jarilla Hills, Otero County; and near Paschal in Sierra County (8).

In Colorado: Near Lajara, Conejos County, just west of the Rio Grande and north of the New Mexico Line (8).

In Arizona: In an outlying spur of the Dragoon Mountains, in Cochise County (8); on Canyon Creek at its junction with the Salt River, in Gila County (4); and near Eldorado and at Mineral Park, Mohave County, the latter the most extensively worked deposits in the state (8).

In Nevada: At Sugar Loaf Peak in Clark County (8).

In California: North of Silver Lake, in the Turquoise Mountains, in San Bernardino County, near the Nevada line (8 and 10).

At some of these places the mines were hardly more than quarries as at Canyon Creek, while in others extensive pits and tunnels were worked through solid rock. The method of working out the stones was dependent upon the position of the deposit in the country rock and upon its extent. All this turquoise occurs in fissures, joint planes, etc., in crystalline rock. On account of the hardness of this rock, special methods of removing the turquoise had to be employed. Mining tools were most crudely shaped heavy mauls, hafted with a stout handle, but often discarded axes appear to have been used, and also picks of deer horn. The country rock containing the mineral was heated by means of fires, and suddenly cooled by throwing water over it, causing it to break. The rocks thus detached were then broken by pounding with heavy mauls until the small bits of turquoise could be pried out. Much evidence of this fire process is to be seen at the Cerrillos mines and elsewhere. The use of fire must have caused the loss of a great deal of fine turquoise which turns white with heat, but was the only possible means of extracting it. At Mineral Park it is said that early prospectors found remains of raw-hide containers used for carrying water to the mines.

By these primitive methods enormous quantities of material were removed over a long period of years. At Los Cerrillos one mine is in the nature of a large pit 200 feet in depth and 300 feet or more in width, and the debris removed therefrom is estimated to cover 2½ acres. At Mineral Park, Arizona, both pits and tunnels were employed. One pit was five feet in diameter and 30 feet deep, so that a ladder of some sort must have been used in working it. Several tunnels were found extending 20 feet deep through solid granite porphyry, so that a ladder of some sort must have been used in working it. (See illustration on page 190.)

Because of the fact that turquoise mines have only rarely been examined by archeologists, but principally by geologists and mineralogists, there is at present little data as to the time when these mines were worked.

From evidence obtained by archeologists in excavated ruins there was not turquoise used

previous to Basket Maker III (9) or Colonial Hohokam (5), contemporaneous periods of Southwestern prehistory on the Plateau and in the Desert respectively. In working early sites the occurrence or non-occurrence of turquoise should be carefully noted by archeologists.

(4) Haury, Emil W., "Canyon Creek Ruin and the Cliff Dwellings of the Sierra Ancha." *Medallion Papers*, No. 14, Globe, 1934, p. 15 and Pl. LXXI.

(5) Haury, Emil W., "Roosevelt," *Medallion Papers*, No. 9, Globe, 1932, p. 109.

(8) Pogue, Joseph E., "The Turquoise," *Nat. Acad. of Sciences*, Vol. XII, Third Memoir, 1915.

(9) Roberts, F. H. H., Jr., "Shabikeshchee Village," *Bureau of American Ethnology Bulletin* 92, Washington, p. 42.

(10) Rogers, Malcolm J., "Archaeological Reconnaissance of the Mohave Sink Region," *San Diego Museum Archaeology*, Vol. 1, No. 1, 1929.

c.

The Aboriginal Period in Arizona Mining History

This section of an official survey of mineral resources in the state stems from a report prepared by the director of the state's Bureau of Mines in the 1950s. J.D. Forrester, "The Mineral Industry of Arizona," Geology and Mineral Resources of Arizona. Arizona Bureau of Mines Bulletin 180 Pt. 1 (1969), pp. 15-16.

The earliest recorded inhabitants of what now is Arizona were agrarian, early Indian peoples having little knowledge of, or apparent interest in, the use of metals, either for commercial purposes or for ornamentation. However, these early inhabitants learned, in the course of time, of the benefits of such resources as salt, coal, building stone and pottery clay, and, also, of the applicability of particular non-metallic substances for making mauls, knives, spear points, pigments and ornamental beads. According to Dr. Emil W. Haury (oral communication, 1959), there is clear-cut, archeological evidence that mining enterprises, crude as judged by present standards but nonetheless effective and important to such prehistoric peoples, existed by A.D. 1000. Therefore, the aboriginal mining period is considered to extend from A.D. 1000 to about the middle of the 16th century.

Hack (1942) has written of a coal mining industry which was in effect by the beginning of the thirteenth century in the Jeddito Valley along the southern edge of Black Mesa, north of the present town of Holbrook, Ariz. He has noted that the prehistoric Indian people apparently had discovered the use of coal as a means of securing heat at about the same time a similar discovery was made by the early citizens of England.

The coal mines were operated for about 300 years by the early Indians, and the total amount of coal extracted probably exceeded 100,000 tons. This is an amazing amount considering the primitive tools and equipment then available. Coal was used for domestic heating and cooking

and for the firing of pottery vessels, which was a companion industry.

Morris (1928) has described an aboriginal salt mine near Camp Verde in central Arizona which was worked between A.D. 1200 and A.D. 1400. The prehistoric miners recovered salt from layers intercalated with a sequence of nearly unconsolidated sand, gravel, clay and other saline minerals. In the process, they removed thousands of cubic yards of rock material. There can be no question that the ancient inhabitants of the region were engaged in an important salt mining program. Indeed, it probably was the first mining industry of Arizona.

The aborigines also mined turquoise for making jewelry and similar artifacts. Prehistoric turquoise mines have been reported on the east side of Canyon Creek just above the confluence with the Salt River (now Roosevelt Lake in Gila County between Phoenix and the San Carlos Apache Indian Reservation); on Turquoise Mountain in Cochise County; in the Mineral Park area of Mohave County; and in other localities throughout the State.

Although the early aboriginal people of Arizona followed primarily an agricultural way of life, mining also was practiced as part of their total existence. These prehistoric activities were harbingers of the great, present-day mining enterprises of Arizona.

2. Lead in Arizona

Lead usually comes from galena, the sulfite ore of the metal, commonly found with silver minerals and small amounts of zinc. It is a valuable byproduct of silver-lead mining, for which the most notable locations have been Freiberg in Saxony, the Harz Mountains, Westphalia and Nassau, Bohemia, Cornwall, Devon, Derbyshire and Cumberland in England. Also important historically have been the lead-silver mines and smelters in medieval Brittany and nearby Melle in Poitou. Charlemagne reroofed the churches of Rome with gifts of lead from his kingdom. After giving a historical overview of lead mining, our modern source here goes on to inventory the following lead districts of interest to us in Arizona: Old Mammoth Mine, the second largest in output, near Globe, famed for its exotic gemstones; Saddle Mountain in the lower Mazatzal Mountains, near the Old Sunflower mine, a rare mercury-producing site; Bluebird on the San Pedro River; Martinez Canyon, near Florence, with petroglyphs and signs of ancient American Indian occupation; Picacho and Casa Grande. The Yuma Mine just a few miles from Silverbell Road was traditionally viewed as the state's biggest producer of lead but was closed at the time Moore wrote. Richard T. Moore, "Lead and Zinc," Geology and Mineral Resources of Arizona, Arizona Bureau of Mines Bulletin 180 (1969), pp. 182-205.

Lead and zinc have been important to mankind for many centuries. The use of lead can be traced back nearly 5,000 years to the civilization of ancient Troy, in the eastern Mediterranean region, where lumps of the metal have been found in ruins dating between 3000 and 2500 B.C., and zinc, as a compound of brass, was used in China and Rome 2,000 years ago, long before it became known as an element. The earliest use for lead was probably in items of ornamentation, but in later years (500 to 200 B.C.) Athenians produced sizable quantities as

a byproduct of silver mining at Laurium, and used it extensively for pipe in their municipal water system and in the fabrication of utensils for the production of wine.

Lead is a malleable, dark gray metallic element having a relatively low melting point of 327.4°C . and a high specific gravity (11.3). It is so soft and ductile that it can be extruded through dies at ordinary temperatures to form pipe.

Lead rarely occurs as a native element and zinc probably never does. The common ore minerals of lead are galena (lead sulfide), cerussite (lead carbonate, white lead) and anglesite (lead sulfate)... Many of these lead and zinc minerals are commonly associated in the same deposits in Arizona.

In order to produce metallic lead and zinc, their ores, or beneficiated ore minerals, must be smelted. For lead this is a fairly straightforward process involving roasting the ore, if necessary (as in the case of sulfide ores), treatment in a blast furnace to produce base bullion, and then refining the base bullion.

Although early records are incomplete, it is known that lead was produced in Arizona prior to the Civil War. Most of the early production, however, was either as a byproduct of silver mining, or lead produced as a base-metal carrier for the recovery of silver from refractory ores... since 1940, Arizona has ranked eighth or higher among the states in the production of lead, and in the peak year of 1949 it ranked third, when 33,568 tons of lead was mined.

The total recorded production of lead in Arizona, through 1967, is more than 560,000 tons, valued at \$126.8 million and was obtained from more than 250 mines and prospects in 118 mining districts.

Siliceous fissure veins carrying lead minerals, principally galena, and to a lesser extent minerals of zinc, copper and silver, are numerous in the southwestern half of Arizona... It is estimated that Arizona's lead resources total 500 million pounds and that zinc resources amount to about 1,000 million pounds.

3. Copper Mining in Pre-Columbian Mexico

The orthodox view is that there was no copper mining in indigenous America. Charnay and others begged to differ. Claude-Joseph-Désiré Charnay, The Ancient Cities of the New World: Being Travels and Explorations in Mexico and Central America from 1857-1882, trans. J. Gonino & Helen S. Conant (London: Chapman and Hall, 1887), pp. 70-72.

Some historians have proved to their own satisfaction that copper was unknown to the Indians; but had they taken the trouble to read, however slightly, any authority on the subject, they would have paused before they advanced a theory which is entirely at variance with all writers, both ancient and modern. It is an ascertained fact that very rich copper-mines have been worked since the Conquest (between the years 1832-1842, copper-mines were worked successively by an Italian of the name of Chialiva, and others.—Transl.); and in 1873, whilst sinking a shaft in a copper-mine at Aguila, in the State of Guerrero, the miner lost suddenly

the vein; and on examining the cause of the accident an excavation was found 4 ft. 4 in. long, 4 ft. 9 in. deep, and over 3 ft. wide, in which was a rich copper vein from 2 to 4 in. in thickness. The engineer, Felipe Lorainzar, could see no sign of iron or powder having been used, but the walls showed marks of fire; and both the copper ore and the rock in which it was embedded, were shattered and split in various places. In the rubbish were found 142 stones of different dimensions, shaped like hammers and wedges, the edges of which were blunt or broken; these stones were of a different substance from the surrounding rock, clearly indicating that the mine had originally been worked by the natives ("Anales del Museo de Mejico," vol. I; art. by Don Jesus Sanchez).

Copper was likewise found in Chili, Columbia, Chihuahua, and in New Mexico. Before the Conquest, the Indians procured lead and tin from the mines of Tasco, but copper was the metal used in mechanic arts. Hatchets, arms, and scissors were made of copper found in the mountains of Zocatollan. The letters of Cortez tell us that among the taxes paid by the conquered people, figured copper hatchets and ingots of the same metal, which were paid every eighty days. Bernal Diaz (Bernal Diaz del Castillo, lib. I cap. xvi) says that in his second expedition with Grijalva, the inhabitants of Goatzacoalco brought them upwards of six hundred copper hatchets in three days, having wood handles exquisitely painted, and so polished that "we thought at first they were gold." Copper was also found in Venezuela, where, at the present day, jewels of copper, or mixed with gold, crocodiles, lizards, and frogs are found. We procured some and placed them in the Trocadéro, having the same dimensions as those in Central America. Those we found on our first visit to Mitla, are thin, shaped like a *tau*, and hardly 4 in. long. Dupaix found similar hatchets at Mitla, and he thinks they were used as currency, a supposition all the more probable, that an Indian from Zochoxocotlan, near Oaxaca, found an earthen pot containing twenty-three dozen of these taus, but differing slightly from each other both in size and thickness. We read in Torquemada ("Monarquia Indiana," vol. II p. 560), Ixtlilxochitl, in his fourth Relacion, says that the Toltecs used oblong pieces of copper shaped like hatchets, about the thickness of a real), that copper tablets, varying in thickness and shaped like a tau, were used as currency in various regions, and that they contained a large proportion of gold.

Gumesindo Mendoza mentions copper scissors in the Mexican Museum which were found to contain 97.87 lead, 100 copper, 213 platinum, 100 tin, and infinitesimal quantities of gold and zinc. On removing the oxide which covered them the bronze looked like red gold, its density being equal to 8.815; it is harder than copper and breaks under strong pressure, the broken part showing a fine granulation, like steel; but its hardness is less than carburated iron and insufficient for the use it was intended for.

Humboldt says that Peruvian scissors contained 94 lead, 100 copper, 6 platinum, 100 tin, and that their specific weight was 8.815; other scissors analysed by Ramirez yielded 90 lead, 100 copper, 10 platinum, and 100 tin. It seems almost impossible that the Indians should not have used these admirable bronze scissors to build palaces, sculpture their idols and the images of their kings, which are still visible on the porphyry rocks of Chapultepec; and if it is denied

that they w
worked the

*The legend
supposed co
to a small
T10S R10
Sasco, nou
"gold" tho
of Pinal
ten miles
situated t
boasts th
million
Superstit
and Can
Ranch. A
cannot
monolit
identifi
Peoples
Ruins
remin
Treasu
the Pa
part o
Nayla
Treas*

"The
wrot
repe
184

M
to
mi
the
tra

that they were able to carve such hard substances, they must be credited with having easily worked the calcareous stones of Chiapas and Yucatan.

4. White Strangers and Papago Gold

The legend of the lost treasure of Red Rock is one of the most famous in the annals of Arizona. A supposed colony of peaceful, white-skinned Old World miners among the Papago Indians is traced to a small place of the same name in the Santa Cruz valley. Red Rock (population 332 in 2000, T10S R10E) is located in Pinal County north of Tucson, not far from other mining locales such as Sasco, now a ghost town but once a large smelter for the Silver Bell Mine, and Avra (Spanish for "gold" though said by some authorities to mean "open"). The mysterious CIA aeronautic boneyard of Pinal Airpark lies not five miles south. The landmark Picacho Peak rises on the horizon about ten miles north. To the west stretches the large Ironwoods National Monument and to the east are situated the Santa Catalina and Tortolita Mountains and San Pedro river valley. This same region boasts the Silver King Mine, the richest silver mine in Arizona, which produced an estimated \$42 million worth of silver ore between 1875 and 1900, the fabled Lost Dutchman Mine in the Superstition Mountains, Lost Mine with the Iron Door, or Lost Escalante, Lost Mission, Lost City and Cañada del Oro ("gold gulch", Oro Valley), not to mention the Romero Ruin and Samaniego Ranch. A more central location for exploiting the surrounding gold, silver and other precious metals cannot be imagined. Mining history expert Flint Carter draws attention to ten-foot-tall ancient monoliths with line and dot markings near the entrance to Oracle Ridge mines, which have been identified as being in an Ionic script 2,800 years old, contemporary with the Phoenicians and Sea Peoples. Is it sheer coincidence that there is a town named Toltec nearby, or that the Casa Grande Ruins National Monument (Siwañ Wa'a Ki, "House of the Governor") stands as a colossal, lonely reminder of age-old trade and commercial ties? See Robert E. Zucker, with William "Flint" Carter, Treasures of the Santa Catalina Mountains (Tucson: BZB, 2014). The rancheria mentioned in the Papago account may, in fact, be the Romero Ruin, a Hohokam and Spanish Colonial site now part of Catalina State Park. Leland Lovelace, Lost Mines and Hidden Treasure (San Antonio: Naylor, 1956), pp. 109-111. The legend is also told in Thomas Penfield, Dig Here! (Tucson: Treasure Chest), pp. 76-77.

"The route from Tucson passes through a country abounding in exceedingly rich gold mines," wrote Major P. St. George Cooke, commanding the United States Second Dragoons, in his report to Colonel J. J. Abert, of the United States Topographical Engineers, December 6, 1847.

Major Cooke and his company of dragoons were blazing a trail across the Arizona wilderness to California. It is not clear how he got his information about the "exceedingly rich gold mines," though he certainly was correct. He did not, however, know the ancient tradition of the Papago tribes through whose territory, south and west of Tucson, he traveled in safety: the tradition about the strangers with the milk-white skin, who came among them mysteriously,

MERCHANT ADVENTURER KINGS OF RHODA

and were cruelly slain by the enemies of the Papagoes before the tribesmen had learned the strangers' history.

The prehistoric Papagoes who claimed the region from northern Sonora to the Gila River, lived in a country rich in gold and silver. Finding the precious metal in such profusion in its native form, they used it freely for ornaments and utensils, regarding it wholly for beauty or for common use, since they had no conception of money. They gave it away freely, never knowing any reason for hoarding it, on the principle that, no matter into whose hand it came, it would eventually serve the purposes of Montezuma. This was their attitude until they learned that gold was the cause of all their trouble with the white men, when the white men came to settle among them.

In a time so long ago that the Papagoes cannot date it, some gentle-mannered, peaceful white foreigners came among them, lived with them for a little while, and did so many kind things to earn their affection and respect that the Papagoes looked upon them as demi-gods.

These strange men wandered about Papaguera collecting all the gold and silver they could find, and in various honorable ways, acquiring it from the natives. Thus they secured a great mass of it.

The foreigners made their headquarters in a rancheria thirty-three miles northwest of the more recent city of Tucson, near the present little village of Redrock, in Pinal County. Somewhere along the road out of Redrock to Silverbell, in a southwesterly direction, they concealed the masses of gold and silver that fell into their hands. In a few years they had a fabulous amount collected and stored. But bear in mind, at this time there was no Redrock, no Silverbell.

What the strangers intended to do with all this treasure is not accounted for in the Papago tradition, though they tell its destiny. They say that one day a tribe of the Papagoes' enemies from the north—perhaps the forerunners of the Apaches—fell upon the rancheria and killed everyone there. Not a Papago nor a white stranger was spared.

When the tribesmen from farther south visited the rancheria soon thereafter, they found it in an unwonted silence, leveled with the ground, with not a living thing on two legs or four. They knew at once what had happened.

About twenty-five or thirty years ago, some spears, swords and other objects, marked with archaic Latin inscriptions, were unearthed in this region, and gave rise to considerable speculation and controversy among archaeologists. By some it was claimed the objects were faked; others believed in their authenticity. If authentic, then one thing is certain; they had at one time been the possessions of inhabitants of Europe, persons above the common class, who had been educated in the language then current for writing. This would apply to almost any country of Europe where the people were literate in the Middle Ages.

Did these objects once belong to the men of the milk-white skin who so long ago came among the Papagoes? And were they the Norsemen of the upper class, educated, literate, skilled navigators and geographers? No one can now say.

The objects described above were found at what was perhaps the campsite of the long-gone

foreigners; their treasure cache was no doubt a little distance away. But neither Indian nor white man has ever discovered the huge treasure buried by the strange men from overseas in the prehistoric days. Where they buried it, there it remains.



Bearded Semitic merchant wearing *keffiyah*, from Hodges Ruin, Tucson, dated to Cañada del Oro period ca. 500-700. *Rafael Serrano, after figurine published in Kelly (1978).*

5. Ancient Mines of the American Southwest

Two reports from the files of the Tombstone Epitaph inform us about ancient mine workings and tools. This seems to prove, at least, that early miners were cognizant of following in the footsteps of those from long ago. Wayne Winters, Forgotten Mines and Treasures of the Great Southwest (Tombstone: Tombstone Nugget, 1972), pp. 15-16, 67.

a.

Finds an Old Mine

**A Lost Mine in Arizona That Was Worked by Ancients with Stone Implements
A Large Excavation Which Represents Many Years of Labor with Crude Instruments**

April 22, 1904

A.E. Stafford has returned from a trip to Canyon Creek, about thirty miles north of Globe, where he examined an old mine, supposed to have been worked by the Spaniards in very early days, or by a people antedating them, as all the implements found are of stone. The ground is supposed to have been mined for silver, though considerable turquoise, in small pieces, is scattered through the dumps.

MERCHANT ADVENTURER KINGS OF RHODA

The development of the old mine was extensive, and to duplicate which today, Mr. Stafford says, would cost more than \$50,000.

The old workings have the appearance of having been filled in purposely with waste, and there is only one opening—a tunnel—which it is possible to enter. This Mr. Stafford explored and found to be about forty feet in length. He found upwards of fifty stone hammers of various sizes in this tunnel.

The old mine is quite interesting and its exploration might possibly develop something of value; but, being on the San Carlos Indian Reservation, no prospecting of consequence has been attempted.

b.

Texas Ancient Workings

August 13, 1890

C. C. Fitzgerald, who is working the Cook's Peak mines, claims to have found evidences of early workings in the lower levels. He tells a Tribune reporter at El Paso that progress of development on this property has opened out a mine worked probably two thousand years ago and no doubt by the Aztecs. The chamber and tunnel leading to it are worthy of note, as the manner of work in mining science of that age seems well defined by the charred walls, which were heated and rendered friable by applying water to the heated surface.

Hammers, made of trap rock, or phonolite, shaped at one end to fit the hand and rounded at the other, using the arm of the workman as a handle to the instrument, were found. The picks, made similarly, are rounded in the center to admit the grasp of both hands, using the ends in the manner of using the picks of the present day.

A limestone capping of fifteen feet had formed over the entrance to the mine. This fact serves as a record of the age of the discovery, as it could not have formed to that extent in less than the time mentioned.

6. Mine with the Iron Door

This miner's tale is probably the best known in Arizona. Interesting are the details of stone buildings and the Latin language. Any inscriptions left by the Jesuits would have been in Spanish, not Latin. Did the Jesuits of the eighteenth century re-open one of the Romani's lost goldmines? Arizona Daily Star, "The Iron Door Mine" (letter to the editor), Feb. 28, 1880, p. 4.

There was supposedly also an Iron Door Mine on a mountainside in Tumacacori. For other such stories, see Byrd Howell Granger, A Motif Index for Lost Mines and Treasures Applied to Redaction of Arizona Legends, and to Lost Mine and Treasure Legends Exterior to Arizona (Tucson: Suomalainen Tiedeakatemia and U of Arizona P, 1977), pp. 28-32. The author Harold Bell Wright, said to be the first American novelist to make \$1 million, wrote a bestseller titled The

Mine with the Iron Door in 1923. There have also been several Hollywood films with the same title. See Robert Zucker with William "Flint" Carter, *Treasures of the Santa Catalina (Tucson: BZB, 2014), esp. pp. 164-72.*

The Nine Mile City of the Santa Catarinas The Story As Told to Our Correspondent

In yesterday's Star we promised to publish the balance of a communication received from the Santa Catarinas (former name of Catalinas), and here it is:

Martin & Welden's Camp, Feb. 24, 1880

Yesterday there were two men stopped here, and they had a very interesting story to tell, and I here furnish to the Star for publication the text of it; but I do not authenticate it, as sometimes prospectors are liable to exaggerate. Probably all of the old Arizonans in this vicinity have heard the tradition of the Santa Catarinas, and for the benefit of those that have not I will give the outline of it:—About one hundred years ago the Jesuits held full sway over the population in this territory, and at that time they had large fields under cultivation, and many men employed delving in the earth after the precious metals and the turquoise stone. At that time the principal gold mines were situated in these mountains, and there was a place called Nueva Mia Ciudad, having a monster church with a number of golden bells that were used to summon the laborers from the fields and mines, and a short distance from this city, which was situated on a plateau, was a mountain that had a mine of such fabulous richness that the miners used to cut the gold out with a *bacheta*. At the time of the Franciscans acquiring supremacy the Jesuits fled, leaving the city destitute of population; before their flight they placed an iron door on the mine and secured it in such a manner that it would require a considerable time to unfasten it. There were only two entrances to the city and they also were closed and all traces obliterated so as to throw the San Franciscans off the road to this Nueva Mia city. These are the facts of the tradition as briefly stated herein, and now for the story of the prospectors, or whoever they may be.

They told me that they had come here on January 10th, 1880, for the express purpose of exploring the mountains for the Nueva Mia Ciudad (nine mile city) and the mine of the iron door. We had heard for years of this place but did not put any credence in it; but about five months ago we were traveling in Sonora on a prospecting tour, and one night we stopped near the town of Caborca with an old Mexican and his wife, and he was asking of Arizona and other matters and at last about mining. We gave him all the information we could, and told him how Tombstone was a booming camp, when he spoke up and asked us if we ever had heard of the mine of the iron door? We said yes, but that we did not place any confidence in the story. He says I do, because I have a book here my grandfather had, and that he was one of the inhabitants of the Nueva Mia city. We became excited over this statement and asked him to

MERCHANT ADVENTURER KINGS OF RHODA

produce the book. He went into an inner room and returned with a book covered with a black cloth and leaves of parchment. He gave it to us and we opened it and found that it was written in a bold, round hand, but very faded. We judge it has at least 400 pages, and contained a kind of a diary of events of those days, a history of his life, and a description of the Nueva Mia city and how to reach it; also full directions how to find the mine of the iron door. We offered to buy the book of the old man at a good round figure. No, he said, I don't want to part with it, for it is the last remnant of this old family but we could copy any part of it that we wished. We camped there for several days, making extracts from the book, and one in particular which we remember: "I worked to-day with ten other men and we took out 200 pounds of gold." You can imagine what excitement it caused with us. After getting all the information we desired from this old book we packed up our provision and started for Arizona.

We having business in Florence, we proceeded there and outfitted. One of us was taken sick, and we were consequently delayed until January 10.

When we arrived in the Cañada del Oro, from the descriptions we found it would be necessary to proceed on foot from this point, and turning our horses and burros loose to shift for themselves, we shouldered our packs, and took the middle canyon that led in an easterly direction from Cañada del Oro. It was about noon as we started up the canyon, and we were not quite sure that we would reach the place where water was said to exist the year round by our directions, but we plodded onward and upward over the largest boulder, now passing through places where the very tops of the canyon would fairly join, and then opening out larger in box shape. Toward evening we came to a living spring of water, and here we camped for the night. Everything passed off finely that night, with the exception of the bears coming uncomfortably close, and the thrilling scream of the panther. In the morning we cooked our breakfast, and as we sat down to partake of it we took out our directions and examined them. We found that after we had traversed the canyon for a distance of about five miles we would come to where it divided, and that we must take the right hand canyon and journey up it for a half mile when it would come to an abrupt end with precipitous sides, and that on close scrutiny would find on the left side steps cut that would lead upward to a shelving rock, and there would appear to be a mouth to a cave, but to push onward through this and you would come out on a shelf of rock on the other side.

After finishing our breakfast we followed up this large canyon about four miles, when we came to where it divided into two. We took the right hand one, and in the course of half an hour or so we came to where the canyon suddenly became walled in on three sides, and after a considerable hunting we discovered what seemed to be an old stairway cut in the rock; we had a terrible time in getting up them as they were nearly obliterated by the decade of time, and we kept slipping back and back, but at last we reached a shelving rock; and on the face of the perpendicular wall was an opening that would admit of an entrance to a full grown person. We held a consultation together whether we had better proceed or return, and at twig-pulling it was decided that we should enter. We took some candles from our pack, unslung our "Henry's," in case of emergency, and passed in the opening. We had not got far when a large

flock of bats commenced circling around us, attracted by our lights. The place was chilly but perfectly dry; in size it varied, first opening in a vaulted chamber of large proportions and then closing into a narrow passage, and in place we noticed an inscription engraven in the wall in Latin—*Dominus vobiscum*, and from that we commenced to gain more confidence that we were on the right track. In about an hour we saw a light ahead, and in a few minutes we came to an opening, we passed through, and down about 200 feet below us was the finest scenery that we ever beheld. It was a tract of land covered with pines and oaks, broken by small hills, and through it passed a stream of water that glistened like silver. We looked for a place to descend but could find none. We took the ropes of our packs and spliced them together, and secured them in such a manner around a jutting rock that they could be unloosed from below. We lowered our packs and guns and then descended, hand over hand. We sat at the bottom for some time examining our directions; they told us that by traveling in an easterly direction we would come to the Nueva Mia Ciudad. They did not give us the distance, so we concluded we would find water and pitch stakes for the night, in about twenty minutes we came to the stream of water we mentioned before; it was literally alive with trout, and without any difficulty we secured enough for supper, and as we were cleaning them we noticed shining particles in the stream. We took our break pan and washed it, and in it was about a dollar's worth of gold. You cannot imagine what an exciting time it caused. I don't think we will ever forget it in our life. Then we were doubly anxious to look for the old city and mine with the iron door; but we had to content ourselves for the night, but I can assure you we did not get much sleep. Before daybreak we had our breakfast and had everything packed for an early start. We set our compass and started easterly and had not gone more than a mile before we came on to ruins, which, as we proceeded, grew larger and could be seen for two miles in width. We think, probably, that we had walked four miles when we came upon a stone building (granite and marble) that was in a fair state of preservation excepting the roof which had fallen in; the structure was something after the style of the old (Cocospera) church in Sonora (ruined adobe mission founded by Father Kino in the Magdalena valley south of Nogales in Mexico), and we decided that this must have been the place of worship for the people of this once populous city. Here we spent some time in looking over this edifice searching for gold and silver which was buried in the church, but having no tools we could do nothing. We camped here for several days looking over the old ruins, and found several stones bearing inscriptions in Latin.

We then changed our camping ground and commenced to look for the mine of the iron door, and after three days of searching we found it. The old door was eaten off by rust, and the bars of iron that secured it lying down at the mouth of the tunnel. We were afraid to enter for fear of wild beasts; but the love of excitement got the best of us and we entered. We saw at the commencement that the vein was about ten inches wide with a tall gouge, and, as we neared the end of the tunnel, which must have been about 400 feet in length, the air became very foul, but we pushed through; there we found some old iron resembling in shape the pick, we took it up and struck it in the vein and to our amazement the fold rolled down in nuggets to the floor. Such a sight we never before saw. We worked for several days on the mine with

the old tools there, and we will show you what we took out. [Here the two men unpacked from their burros and showed me, I should judge, 100 pounds of pure gold in nuggets.] We put on our location notice and packed up, and have got back as far as this. We go to Florence and will return as soon as possible. I asked them if they thought it would pay me to go and locate placer claims, and they told me most assuredly. I and my partners leave to-morrow for the Nine Mile City. If a lie we will stand it; if not, so much the better. I tell you those golden nuggets give us a good deal of faith; and further, I am one of the oldest prospectors in these mountains and I have never known anyone to go up these canyons. I will write you as soon as I return.

Respectfully, Redoubtable [Martin].

7. The Spanish Took over Indigenous Mines

*At first the conquering Spaniards did no prospecting in the New World. They were here for plunder, not mining. This brief extract from Carlos Prieto's study exposes the modus operandi adopted by Cortez and the other Conquistadors: demand all the gold that could be melted down, identify its sources in official tribute books and dispatch expeditionary forces to "different and distant territories" to ensure a steady flow of it. In no case, was there ever any effort to prospect for new veins of the metals. All the mining centers had been discovered and opened by earlier owners. They were being worked by indigenous slaves according to an established system with pre-Columbian technologies. The Spanish reached Nayarit's rich silver lodes in 1525 and occupied Michoacán about a decade later. Tlalpujahua in the latter province had the most valuable gold-producing mines in the entire world in the early twentieth century. When the Jesuits and Franciscans set up the mission systems in North Mexico they used the same approach. In Peru, on the other hand, no native shafts were found, only placer deposits. (a.) Carlos Prieto, *Mining in the New World* (New York: McGraw-Hill, 1973), pp. 20-21. (b.) W. H. Prescott, *History of the Conquest of Mexico* (London: Phoenix, 2002), pp. 66-67.*

a.

Evidence of the existence of gold and silver deposits was collected by the expeditions of Francisco Hernández de Córdoba in 1517 and Juan de Grijalva in 1518, both of which reconnoitered the coast of Middle America before the Conquest, and by the expedition of Cortés himself in 1519. Andrés de Tapia, a member of Cortés's expedition, tells us that on the coast of San Juan de Ulúa, Veracruz, Cortés received a gift from Montezuma II consisting of "one gold wheel and another of silver." Each was a big as a cartwheel, though not very thick, he reports, and "they say were made to represent the sun and the moon." Cortés lost no time after the Conquest in sending explorers to different and distant territories where he had been informed of the existence of precious metals and where, as Bernal Díaz tells us, "According to the books of Montezuma [Montezuma II] we saw from whence they brought the tributes of gold, and where there were mines." It is certain that the first Spaniards to work gold mines in

New Spain on a permanent basis were those whom Cortés sent “to the matter of Tustepeque” (Guacaluco or Coatzacoalco in Vera Cruz). Bernal Díaz even gave the names of the miners (directors) who stayed behind to work.

b.

The Mexicans were as well acquainted with the mineral as with the vegetable treasures of their kingdom. Silver, lead and tin they drew from the mines of Tasco (Taxco, southwest of Mexico City); copper from the mountains of Zacotollan (Zacatlán, in the Pueblo region of North Central Mexico, a Toltec area). These were taken not only from the crude masses on the surface, but from veins wrought in the solid rock, into which they opened extensive galleries. In fact, the traces of their labors furnished the best indications for the early Spanish miners. Gold, found on the surface, or gleaned from the beds of rivers, was cast into bars, or, in the form of dust, made part of the regular tribute of the southern provinces of the empire. The use of iron, with which the soil was impregnated, was unknown to them. Notwithstanding its abundance, it demands so many processes to prepare it for use that it has commonly been one of the last metals pressed into the service of man. The age of iron has followed that of brass, in fact as well as in fiction.

They found a substitute in an alloy of tin and copper, and, with tools made of this bronze, could cut not only metals, but, with the aid of a siliceous dust, the hardest substances, as basalt, porphyry, amethysts and emeralds. They fashioned these last, which were found very large, into many curious and fantastic forms. They cast, also, vessels of gold and silver, carving them with their metallic chisels in a very delicate manner. Some of the silver vases were so large that a man could not encircle them with his arms. They imitated very nicely the figures of animals, and, what was extraordinary, could mix the metals in such a manner that the feathers of a bird, or the scales of a fish, should be alternately of gold and silver. The Spanish goldsmiths admitted their superiority over themselves in these ingenious works.

8. Slavery and Mining

*From the earliest of times to twenty-first century Minas Gerais in Brazil, mines have been worked by slave labor, often disproportionately by women and children. It is clear that the “Roman” governors of Rhoda took over a Toltec tribute and *courvée* labor system. To free the slaves, as Israel III and Quetzalcoatl are said to have done, was an extreme move, one that could only have been motivated by fervent religious beliefs. Here is how Diodorus Siculus, a Greek historian, described the working conditions of slaves in the Bishari goldfields about 50 BCE, quoting the lost author Agatharchides, a geographer of the second century BCE. Alexander del Mar, A History of the Precious Metals, 2nd ed. (New York: Burt Franklin, 1902), pp. 39-40. A more extensive translation may be found in the notes of Hoover (Herbert Clark and Lou Henry Hoover, Georgius Agricola. De Re Metallica, translated from the First Latin Edition of 1556, New York: Dover,*

1950, pp. 281-82).

On the confines of Egypt and the neighboring countries there are regions full of goldmines, whence with the cost and pains of many laborers, much gold is dug. The soil is naturally black, but in the body of the earth there are many veins of shining white quartz, glittering with all sorts of bright metals, out of which those appointed to be overseers cause the gold to be dug by the labor of a vast multitude of people. For the kings of Egypt condemn to these mines not only notorious criminals, captives taken in war, persons accused of false dealings, and those with whom the king is offended, but also all the kindred and relatives of the convicts. These are sent to this work, either as a punishment, or that the profit and gain of the king may be increased by their labor.

There are thus infinite numbers thrown into these mines, all bound in fetters, kept at work night and day, and so strictly surrounded that there is no possibility of their effecting an escape. They are guarded by mercenary soldiers of various barbarous nations, whose language is foreign to them and to each other, so that there are no means of forming conspiracies or of corrupting those who are set to watch them. They are kept to incessant work by the rod of the overseer, who often lashes them severely. Not the least care is taken of the bodies of these poor creatures; they have not a rag to cover their nakedness; and whoever sees them must compassionate their melancholy and deplorable condition, for though they may be sick, maimed or lame, no rest nor any intermission of labor is allowed them. Neither the weakness of old age, nor the infirmities of females, excuse any from the work, to which all are driven by blows and cudgels; until borne down by the intolerable weight of their misery, many fall dead in the midst of their insufferable labors. Deprived of all hope, these miserable creatures expect each day to be worse than the last, and long for death to end their sufferings.

9. Concerning the Ore of Gold and Where to Find It

Gold, a shiny and immutable metal or element (Au), is found ubiquitously but unevenly around the world. It is widely distributed in small amounts and has the physical properties of hardness, malleability and heaviness, with a specific gravity of 19.3 when pure. Miners recover it by panning streams and rivers and sifting alluvial gravel ("placers") or by following them up to their sources in hills and mountains, delving into the earth, sinking shafts and creating tunnels and galleries. Prospectors throughout the ages look for it in veins or ledges of quartz rock, its most common "matrix." These plutonic deposits from eons ago in the earth's geology are sometimes exposed on its surface, sometimes hidden beneath it. The average placer gold has a purity of 85%. When gold contains an unusually high percentage of silver it is known as electrum. Unlike copper, gold rarely forms in pure nuggets, and large pieces similar to float copper are very rare. It must be recovered by smashing and breaking the ore, washing, smelting, cupellation and, traditionally, amalgamation with mercury or cinnabar. Byproducts are silver, copper, arsenic and lead. The waste is gangue or tailings. Sluice boxes, leather bags for squeezing mercury from an amalgam, mills, crushing and

rolling trays and furnaces for smelting are familiar to people since the days of the pharaohs. Here is some advice from a Renaissance manual in Latin still used by hobbyist gold seekers today. Cyril Stanley Smith and Martha Teach Gnudi, The Pirotechnia of Vannoccio Biringuccio (New York: Dover, 1990), pp. 29-30.

I say that gold is generated in various kinds of rocks in the most rugged mountains that are completely barren of soil, trees and grasses. And of all the rocks for such metal the best is a blue stone called lapis lazuli, which has a blue color similar to the sapphire, but is neither so transparent nor so hard. It is also found in orpiment (sulfides) and even more it is found associated with the ores of other metals (silver, lead and copper). Much is also found in the river sands of many regions (alluvial deposits). That which is found in mountains is in the form of (quartz) veins between one stratum and another, united with the blue rock, and indeed is much mixed in with this. They say that such ore is better the heavier and the more full of color it is, and the more flecks of gold appear in it. They also say that it is generated in another rock similar to saline marble (limestone) but of a duller color, and in still another rock whose color is yellow with many red specks in it (calcium magnesium carbonate?). They also say that it is found in certain black rocks, scattered loosely about like small stones in a river. And furthermore they say that it is likewise found in a certain bituminous earth of color similar to clay and that such earth is very heavy and has a strong sulfurous odor. The gold extracted therefrom is very beautiful and almost completely pure, but it is very difficult to get out because it is of the finest grain, almost like atoms, so that the eye distinguishes it with the greatest difficulty. Nor can one proceed as with lapis lazuli or other rocks or as one treats river sands, for when it is found there, and even more when it is washed, it falls only with difficulty to the bottom, and, growing vitreous on melting, it becomes pasty with the matrix and its earthy matter. Nevertheless, in the end it is possible to recover it using the greatest patience with one method or another and finally with mercury (the amalgamation process).

In my opinion, if it is not a rock you wish to save, the best method for reducing it to purity would be to roast the ore in a slow fire in an open furnace and cause it to evaporate well. Then wash it thoroughly in order to extract from it all the superfluous matter, and then purify it by smelting it [on a lead bath] in a cupeling hearth of a size depending on the quantity, or on a very hot cupel, throwing off the lead as litharge or consuming it and reducing the gold to purity.

10. In Case You Should Ever Need to Invent a Copper Bell in a Hurry

Familiar images in Buddhism, copper bells have been found in pre-Columbian archeological contexts throughout Mesoamerica, including Snaketown, the classic Hohokam horizon site excavated by Harold Sterling Gladwin and associates in the 1920s (Excavations at Snaketown:

Material Culture). *Their puzzling distribution and technology have been carefully studied (see, for instance, the works of Dorothy Hosler), but few archeologists are willing to concede that their high-status owners may have been devotees of trans-Pacific cultures, or that their intricate manufacture was learned via Old World diffusionist influences. In this belletristic jeu d'esprit—perhaps unique in the dry-as-dust literature of archeology—the excavator of Snaketown describes how hard it would be to make copper bells without the benefit of long traditions and exacting tutelage. The same period ("Pioneer" to "Colonial") produced the leaden inscriptions and modeled crosses of the Tucson Artifacts, which some detractors have claimed were cooked up with ordinary typographer's lead on a kitchen stove as a hoax. A more academic treatment of the subject of copper-smelting technology in the New World comes from Stephen C. Jett, "The Origins and Early Diffusion of Nonferrous Metallurgy in the Old World: A Review," *Pre-Columbiana: A Journal of Long-Distance Contacts*, vols. 5-6 (2011-2014), pp. 258-261. After canvassing the evidence for and against independent invention, Jett concludes, "My vote is for a historically globally unified technology complex." Harold Sterling Gladwin, *Men Out of Asia* (New York: Whittlesey House), pp. 297-301.*

The technique of casting by the lost-wax method was very ingenious, and in case you should ever need to invent a copper bell in a hurry it will save you a good deal of time and trouble if we give you a few hints on how to go about it. We hasten to add, however, that our offer of assistance should not be regarded as reflecting any doubt on your ability to independently duplicate each step in the entire process, since we would not dare to imply that you might fail where Duddy's "American Indians" are said to have succeeded in duplicating each and every detail without help of any kind.

First, if you insist on starting from scratch, you must find some float copper and, as this requires a fortuitous discovery, we suggest a walking trip through Arizona or Michigan where copper in the raw can be discovered without too much emphasis on luck.

Next, you melt off a drop into a bucket of water to make the pellet which will become the clapper of your bell. Copper is a good conductor of heat, so it will be just as well to invent some sort of contraption to hold the copper when it gets too hot for your fingers. We take it for granted that you will not cheat by using metal tongs.

Now take some mud. Mix it up with a little charcoal. Put a copper pellet in the middle of the lump and mold it to the shape of a pear. This will form the clapper and the inside core of the bell, and you judge the size accordingly.

Now apply a coating of wax; beeswax will do if you haven't invented paraffin.

Cut a slot in the wax across the lower half to form the lips of the bell.

Make a small ring of wax and stick it to the top of the wax-covered core.

Incise some lines or other form of decoration to suit your fancy in the wax of the upper shoulder of the bell.

Now go back to your lump of raw copper and after it has been well heated draw it out to a thin thread, just as if it were chewing gum. Snip off half a dozen short lengths about half an

inch long and stick them into the core, to serve as spacers in keeping the mold away from the pear-shaped core.

Mix a thin solution of clay and paint it carefully over the wax-covered pear. The clay must be sufficiently fine and clean and the solution must be thin enough to find its way into all the details of the modeled wax.

Repeat with four or five more coats, then take two handfuls of good clay and encase the model in the middle. Add one or two more handfuls until you have a good solid ball of clay.

Now add a good-sized lump, about the size of your fist, to the top of the ball and form it into a cornucopia with flaring sides.

Dig down through the center of the cornucopia until you find the top of the wax ring on your pear-shaped core.

Now set everything out in the sun to dry, and when say dry, we mean *dry*.

Next place the mold in a good, hot fire. It will only take a few minutes to find out if the ball of clay is dry enough, as any moisture in the middle will quickly become steam, with results that are rather unpredictable.

If the clay has dried out well without cracking the wax will soon melt and evaporate.

Now put a few pieces of raw copper in the cornucopia. Set the whole contraption back in the fire and heat until the copper melts. The molten copper will slowly work its way down to the ring and plug the hole at the bottom of the cornucopia, so that when the mold cools a partial vacuum is created in the space formerly filled with the wax that was driven out by evaporation. Molten copper will thus be drawn down into the mold, and, by repeated heating, it at last percolates down and completely replaces the wax.

After the clay has cooled break away the mold, and it is barely possible that you will find a copper bell filled with baked mud and charcoal. If you have been lucky and skillful and everything has gone well you can now pick out the mud and charcoal with a bone point and you will have a nice little copper bell with a copper clapper.

Although we have never tried to make a bell in this way it is not hard to see that there are one or two things that might go wrong—bubbles and impurities in the wax, the copper, the clay or all three. The blast furnace must be raised to 1000 degrees Centigrade before the copper will flow. The mold may be porous or otherwise imperfect. Core, cast and mold may stick together. Geysers of boiling wax, molten copper and exploding molds add zest to the experiment, and, all in all, it is fairly complicated process. It is therefore not surprising that the craftsmen of India and the Middle East have been mucking around with copper for 2000 years or more before they were able to ring a bell by this method.

11. Tucson Mining Districts at Dawn of American Settlement

This survey attests how rich in all valuable ores the mountains around Tucson are, in particular the Santa Cruz, Cañada del Oro and San Pedro valleys, all within easy reach of Tucson (ancient Rhoda). Richard J. Hinton, The Handbook of Arizona: Its Resources, History, Towns, Mines,

Ruins and Scenery (*San Francisco: Payot, Upham, 1878*), pp. 116-18, 127, 136ff., 145, 180, 182, 186, 189, 201, 205, 268-69, 403.

In Pima County the mining districts are at once the oldest and the newest on the Pacific slope, north of Mexico. They are mainly in the Santa Cruz valley, and a region to the west thereof once known as Papagueria, inhabited by the semi-civilized ancestors of the present Papagoes. Traces are not wanting of their having been worked even anterior to the Spanish conquest of Mexico, by a people superior to the Spaniards of that day in nearly all the useful industries, and only excelled by them in the industry of slaying and marauding.

In the last century, one of the most notable of the lost mines of what is now Arizona was that called *Planchas de Plata*—the “planks of silver.” Its exact position is unknown now, though the neighborhood in which it was found is plainly indicated by the old records and letters. Don Manuel Retes, in an essay on the mineral resources of northern Sonora, says: “This mineral deposit, situated $31\frac{1}{2}$ deg. North and in longitude $111\frac{1}{2}$ deg. west of Greenwich, is described by a Yaqui Indian towards the commencement of the last century: Distant from four to five leagues from the mine of Arizona; about fifteen from the town of Tumacacori, the nearest settlement; about twenty-five from the Presidio of Santa Cruz; nearly ninety from Ures, and about 130 from Guaymas. The silver was discovered in sheets of different sizes, from which the name of ‘*Planchas de Plata*’ originated. They were found almost on the surface, perfectly pure, and without adhering to any foreign substance, in a flexible state capable of receiving impressions, and only hardening on being exposed to the atmosphere. The region which produces them is an earth of the color of, and very much resembling, ashes, which extends in visible leads more or less wide, and in parts subdivided into veins, over all the hills and mountains adjoining the main deposit. Among the sheets extracted two are worth mentioning, especially one which, on account of its almost fabulous size, (weighing 149 arrobas) it was found necessary to employ the heat of four forges at the same time to reduce it to a smaller bulk. The other weighed twenty-one arrobas, though, according to other accounts, it was much larger. The amount of silver extracted within a very short period was 400 arrobas, or five tons.”

The Sopori ranch and mines lie nine miles south of Tucson, and a little south of the Papago reservation, with its famous mission church of San Xavier del Bac... There is an old silver mine on the estate, which was formerly worked... The San Xavier mine is an old lode, long known and partially worked by Mexicans, six miles west of the Santa Cruz river and 500 feet above its level. The ore consists of argentiferous carbonates and sulfates of lead....

The Oro Blanco district is best known because of the Ostrich mine (gold) located therein. It is eighty miles southwest of Tucson, and is found to extend along a distance of more than 6,000 feet... This old mine is claimed to be the old and lost Tumacacori, where the Jesuit operators were totally extinguished by the Apaches. Other mines, however, make the same claim. Skeletons in the works and the very rich ore on the dump indicate that the workmen stayed by the mine until killed by Indians... The ruins of old arrastras and smelting works show that many mines were worked there “in ye olden time.”

On the western portion of the Santa Rita mountains...woodland and water are abundant in the immediate vicinity, and the adjacent valley of the Santa Cruz furnishes a liberal supply for nearly all gastronomic requirements of man or beast. In this and on the eastern slope of the same range are a number of old mines formerly worked by the Spaniards... up to October 1st, 1876, 975 mines were recorded in Pima county [including, foremost]: Abercorn, one of a number of old mines, very rich, worked by the Jesuits, and 20 years since by an American company...Aztec, one of the most promising lodes in Arizona... Captive, long worked by Papagoes and Mexicans, lode reported rich... Crystal, Old Shaft... Hamilton, rich fahl and galena, argentiferous, believed to be the famous Jesuit Mine, Tumacacori...Lost Mine, lode large, croppings rich, old workings traced... Salero, two old shafts, very valuable lode, (amalgamation ore), water in shaft, 2 miles from Tumacacori...Trench, Patagonia Mts., 4-10 ft. vein, argentiferous galena, 50 men employed, old Mexican mine....

Between the Gila and Salt rivers, intersected by the 111th parallel of longitude, lie the mining districts of Globe and Pioneer, with the famous mines therein of Stonewall Jackson, Globe, Wheatfield, Miami and others... The Silver King mine was discovered, as is stated, by four farmers living near Florence, named Reagan, Copeland, Mason and Long... It may suffice to state that it lies near a basin at the foot of steep mountains on a little hill, in a belt of brown and gray speich, cutting a country of granite; the vein matter is quartz; the mineral chiefly consists of chlorides and black sulphurets; and much silver nearly pure in character is found in little black nuggets in the quartz. The ores are both milling and smelting... The Silver Queen and Belladonna, in the same district, produce silver and copper, and the ore is of a beautiful color, large pieces being taken out covered with malachite, silver and copper, which sparkle in the sun brighter than emeralds.

Up to October 1st, 1876, 200 mining locations had been recorded in Maricopa county, and 552 in Pinal county.

And so one enters on Tucson, after a journey of three hundred miles. It is not an inviting place, and yet the site commands admiration. Turning to the south, one catches the finely defined outlines of the Santa Ritas. They close in the southern and east lines of this massive landscape. Following the horizon therefrom and turning to the west and northward again, the eye takes in a very bold and rugged range, marked on the latest map as the Atacoso mountains, but known here as the Tubac range, from the fact that the old pueblo of Tubac and famous Mission of Tumacacori are located on its eastern base. There is a broad interval, and then further to the west can be seen, looming dim and purple against the evening sky, the jagged peaks of an irregular mountain formation known as the "Picacho del Alamo Muerto." Across a broad space, along the outer edge of which are misty outlines of another and unnamed range, the eye comes delightedly back to the neighborhood of Tucson, and gazes with pleasure on the well-marked if less elevated range close by, and the lesser peaks of which stand guard close to the town, known by the name of the town itself. Imagine, if you can, this bold, sweeping landscape of mountain and plain, in the foreground of which crowds near to the earth the little adobe city whose gray, ashen uncomeliness is relieved and enlightened by a small rim or setting,

MERCHANT ADVENTURER KINGS OF RHODA

running for some distance along the narrow valley, of exquisitely green fields and trees, and then illuminate the sky that arches over it with all the wondrous hues of Arizona's amazing sunsets—great bars of blazing gold, glowing and crimson royal, deep-tinted purples lie athwart a background of translucent blue, melting toward the horizon line into hues of pearl, pink and faint aquamarine, until at last it all passes away in the warm blue gray of these superb nights, and the golden stars come out to bespangle the heavens and inspire the imagination with awe at their nearness and beauteous harmony.

The upper valley of the Santa Cruz debouches southeasterly from its north-by-west course, leaving the remarkable evidence of catholic power and devotion manifested in the mission church of San Xavier del Bac, at the Papago Reservation. Crossing the eastern edge of the Prima Mining District, the traveler enters on a region of well grassed land, broad and rolling, in which the mountain ranges east and west are still misty in the distance. A shallow stream, fringed with heavy cottonwood and sycamore trees, meanders through a wide interval which rises almost unnoted into a rugged mesa. To the west the outlines of the Picacho del Alamo Muerto (Roskrige and Silverbell Mountains) rise boldly. To the south and east a score of miles away may be traced the serrated lines of the Santa Rita, a mountain range of singular beauty, which grows grandly on one's approaching the ancient town of Tubac. The landscape is a bold one; the gray and hazy outlines of rugged ranges becoming distinct, as they are approached. The effect of the atmospheric foreshortening is very peculiar. The valley offers advantageous places for camping. Starting early from Tucson, the first day's noon will generally find a traveler at one of the sinks of the Santa Cruz, where the water disappears in a shallow bed of gravel and quicksand. The stream has here a fall of 75 feet to mile, and there is abundance of grass for feed... Abundant proofs are seen on every hand of former settlement.

"The old town of Tubac was formerly occupied by a numerous and thrifty population, engaged in agriculture and mining. It is the very center of the mineral region in our territory, and has probably 150 silver mines within sixteen miles. Many of them were worked by the Spaniards and Mexicans in a primitive manner, but not opened to any extent, because they had no sufficient machinery or mining tools."

"Tubac is now a city of ruins—ruin and desolation wherever the eye rests... The mines are proverbially rich; and rich mines will sooner or later secure the necessary protection for working them."

"The ores of the Santa Rita mines fall into two classes—lead ores and fahl ores, considering them mineralogically—or into three, when classified according to the metallurgical process best suited to them in this country.

"1—Smelting ores; galena and such fahl (gray) ores as are too rich in silver to be subjected to other process.

"2—Refractory amalgamation ores, containing a certain percentage of lead, and requiring to be roasted before reduction, whether this be accomplished in the patio, the barrel, or the salt process.

"3—Ores containing rich fahl ores, native silver, sulphuret of silver and other simple and

complex salts of this metal, with little or no lead, needing no roasting for the patio, or no magistral, or very little.

The ores of all this portion of southern Arizona are chiefly silver-bearing—argentiferous galena, sulphurets of silver and black auriferous; also sulphate, combined with iron. The gangue is usually quartz or feldspar. The copper ores are generally gray sulphurets. All such lodes, of silver and copper, show also considerable traces of gold.

"How like a *fata morgana* it looks when you first see it in this enchanted atmosphere; the intensely blue sky overhead, the plain about it covered with sparse grass and fantastic cactus, that hide the sand and make the earth look verdant; the low, white dome and the picturesque buildings clustering about it; the adobe garden walls, with arched gateways, sometimes whitened, sometimes left in their native mud color, toned down by age and the glare of the sun, a tall mesquite tree, or a group of cottonwoods striving heavenward from among the adobe houses; Saddle mountain (Tumamoc Hill), with its ever-changing tints and its strong lights and shades in the far distance, and Sugarloaf or Sentinel hill (A Mountain) to the immediate left. On the plain between town and the Sugarloaf, the ruins of what in any other country I should pronounce to have been a monastery, lift themselves from the fresh, dewy green—venerable, gray and stately—some wild vine creeping stealthily in at the frameless window, and out again at the roofless top.

Tucson is seen to be located about two-thirds of the way southeast, on a huge plain or plateau, which presents many very striking features. The wonderful effects of the clear and rarefied atmosphere are seen here at their best. The great plain or plateau in which just above this place the Santa Cruz sinks for many miles, to enter by a subterranean channel the Gila river, near Maricopa wells, is certainly over 100 miles in greatest length and not less than fifty at its widest, which, from the trend of the encircling mountain ranges, is in this vicinity. Looking north and west the eye rests upon the deep blue faint outlines of ranges at a distance of at least seventy-five miles (Ragged Top and Sawtooth Mountains). Nearer, and in the wonderful foreshortening, which is one of the most charming effects seen here, to the east and west may be seen the bold cones of the Picacho and Desert peaks. They stand out in the translucent sky and the luminous sunrise or sunset, with their wonderful combination of colors, so vivid and startling as to defy even the brush of Turner himself, as if one might walk over to them between breakfast and the gray gloaming which indicates that the night has passed. Nearer and closer, until their serrated summits seem about to bow down to us, on the east, trending from the northwest to the southeast, is a bold and remarkably well-defined mountain range known as the Santa Cataline, which sweeps in a bold semi-circle, framing the Santa Cruz valley in a massive way.

The Arizona ruins show: 1. Remains of extensive towns, with large buildings in the center; 2. Evidence of extensive fortifications; 3. Of mounds, probably ruins crumbled away, excavations and enclosures, the purposes of which are unknown; 4. Traces of extensive works for irrigation; 5. Some evidences of mining, with signs of efforts at careful obliteration; 6. Pottery and stone implements; 7. Painted or cut figures; 8. Proofs that the ancient people were

cremationists and planet-worshippers.

12. Amalgamation Process

Many of the old mines in Pinal County are notable for not only their gold and silver but also for their mercury. It seems likely that our Romani used the simple amalgamation process to recover gold and silver together (urre). The Arizona place-name Oro Valley or Cañada del Oro seems to perpetuate a memory of the medieval Breton presence, regionally diffused here along with Tarascan speakers from Michoacán. The makers of our artifacts evidently used mercury mixed with gold dust as the infill to highlight the lettering of their records. Alexander del Mar, A History of the Precious Metals (New York: Burt Franklin, 1902), p. 134.

It is a common belief, one which will be found in most works of reference, that the employment of mercury for the purpose of catching, saving, or recovering the precious metals, called the Amalgamation Process, was invented by one Medina, in 1557. This belief is erroneous. The fact that mercury, when it touches gold or silver, instantly combines with it, and in case the latter is in the form of powder or grains, forms a compound which we call amalgam, was known and utilized in the most ancient times. These circumstances are attested by the evidence adduced on page 8 of the present work; but we shall presently bring forward other evidence. Meanwhile, it is necessary to observe that there is another, a complicated metallurgical process, called by English writers "amalgamation," but known to Spaniards as the "patio process," patio referring to the court or yard in which the process is carried on. In the patio process the pulverized ores of silver, after being spread over the court, receive a charge of mercury, common salt, copper pyrites and water; the combination being called "magistral." The mixture results in converting the argentiferous portion of the ore into metallic silver and rejecting the worthless remainder.

While there is nothing to show that the ancients were aware of this process, there is abundant reason to believe that simple amalgamation was quite familiar to them. At the present day the natives employ this process in Assam, Bhandar, Dharwar, Jhilm, Malabar, Moradabad, the Punjab, Rawalpindi and other mining districts of India (Lock, pp. 276, 322, 318, 347, 337, 344, 348). It is confidently believed that this practice has continued since the Moslem conquest of the tenth century. It may even be of the greatest antiquity.

Sir Gardiner Wilkinson, A.E., ed. 1878, 11, 213n., says that mercury in flasks has been discovered in ancient Egyptian tombs. This metal was sacred to Hes-Iris, or Osiris, who was the same as Buddha, Bacchus, or Mercury, whose name it bears. "It was probably used by the Egyptians for recovering the precious metals. In the Greek silver mining districts of Laurium there were deposits both of cinnabar (an Indian or Sanskrit word), the ore of mercury and copper, the former of which were worked to advantage. Boeckh, Polit. Econ. Ath. Ed. 1857, p. 416. These deposits, found in such close conjunction, could scarcely have failed to suggest the "magistral" of the Spaniards. At all events, it is quite likely that the Greeks employed simple

amalgamation, for it is treated familiarly by the Romans. It is distinctly mentioned by Vitruvius about B.C. 27, and described by Pliny the Elder about A.D. 73. Says the latter, N. H., xxxiii, 32: "Gold is the only substance that quicksilver attracts to itself; hence it is that it is such an excellent refiner of gold, for on being shaken in an earthen vessel with gold it rejects all dross, clinging only to the gold. The dross being expelled, it simply remains to separate the quicksilver from the gold. This is done by enclosing the mixture—amalgam—in a well-prepared skin, which, being squeezed, exudes the quicksilver, like a sort of perspiration, leaving the pure gold behind." This is precisely the process employed by common miners to-day; the skin used being a chamois bag. Aldrisi—12th century—informs us that during the eleventh century, and "long previously" quicksilver amalgamation was employed by the Arabian and negro miners of Western Africa, Abyssinia, Bodja and Nubia. Humboldt, "Fluctuations of Gold," ed. 1900, p. 27. Amalgamation was employed by the gold miners of Portugal during the reign of King Diniz, 1279-1325. Rep. U. S. Monetary Com. 1876, I, 458. It had probably been learnt from the Arabs. In 1525, "a miner, named Paolo Belvio, was sent with a provision of quicksilver to Haiti, in order to expedite the gold washings by means of amalgamation." Humboldt, op. cit. 26. Herrera, in his history of Spanish-America, says that, although previous to the opening of Potosi the Spaniards knew the art of amalgamating mercury with gold, they were unaware that mercury would amalgamate with silver and that then they discovered it for the first time. Anderson, Hist. Com. II, 76. Herrera must have borrowed his metallurgy from Pliny. It is practically impossible to know that mercury will amalgamate with gold and yet not know that it will also amalgamate with silver, because in subterranean mines both metals are commonly found in the same matrix. Even in alluvial or placer gold there is often a small proportion of silver. That mercury amalgamates with both metals must therefore be a fact familiar to everyone who has used it. What Herrera should have said was, that previous to the opening of the Mexican silver mines by the Spaniards there were familiar with simple amalgamation, but not with the complicated patio process, which may have been the discovery of Medina in 1557, and that in 1571 Pedro Fernandes de Velasco carried this process to Potosi, in Peru. And. Hist. Com. Sub an. 1572, and the authorities therein cited; Beckmann, Hist. Inv. I, 17. I am, however, inclined to the belief, that Medina's invention was merely a modification of, or improvement upon, a patio amalgamation process employed by the Arabian and afterwards by the Spanish metallurgists in Europe. Agricola, who was well acquainted with simple amalgamation, also with the reduction of silver ores by roasting, indicates a third method which could scarcely have failed to suggest the patio process.

13. Prospectors Discover Interesting Antique Mine Excavations in Canyon Creek

This notice from the Globe Silver Belt reprinted in the Arizona Daily Star may describe one of the turquoise mines operated by foreign interests like the Chinese, Indo-Chinese and Chalchihuites in

the Phoenix area during the time our Romani were ascendant. The elaborate nature of the tunnels and shafts surprised the discoverers, as well as their antiquity. For Aztecs, read Toltecs. Arizona Daily Star (Tucson), Wednesday, October 25, 1893, p. 1.

Bud Woodson, Sam Sands, William Beard and R. Scott returned last Saturday from a trip to Canyon creek, where they went to examine an old mine which members of the party had discovered some time before. It is situated near the mouth of Canyon creek and about one mile from the Salt river, being about the same distance within the boundary line of the White Mountain Indian reservation.

The works lie well up on the steep side of the mountains and consist mainly of a series of open cuts into a porphyry dyke, which encircles the mountain. These cuts extend for fully a mile along the side of the mountain and represent an immense amount of labor performed. There is also a shaft, probably 100 feet deep, and the remains of an old tunnel. Near the works in the face of the mountain are several caves excavated in a slate formation, with walls built up at the openings, resembling some of the Aztec ruins, so numerous in parts of Arizona. These excavations were evidently the dwelling places of those who worked the mine, probably Aztecs, or a kindred people, as the mine excavations show great antiquity, being considerably worn by the action of the elements and bearing a growth of large mesquite, most of which is dead and decayed.

The exploring party searched for mineral, but were unable to find anything of value, to justify the evidences of extensive work, which would cost, at the present day, \$20,000 or more. Mr. Woodson is of the opinion that it was a turquoise mine.

The party ascended Canyon creek twenty-five miles and found game very abundant, especially deer, bear and turkeys. Three deer were killed by Mr. Woodson, which furnished all the venison needed on the trip.

14. Camels and Egyptian Characters Painted on Utensils at Ft. McDowell

Reprinted from the Prescott Democrat is this unique item headlined "Antiquities Discovered." It concerns an ancient site outside Phoenix called at the time "the most important discovery made in Arizona." Camels are not known to have lived in the American Southwest until experimentally introduced by the American army in the nineteenth century. Perhaps what these observers thought were camels were either "quadrupeds" of American Indian rock art typology or the humped leviathan of ancient seafarer symbolism as found on the Tucson Artifacts and in a cave containing Hebrew inscriptions on Hidden Mountain near the Los Lunas Decalogue Stone (see IX.12). Mastodon-like beasts are also mentioned. Arizona Daily Star, Wednesday, June 7, 1882, p. 3.

Within 75 miles of Prescott, in the vicinity of Fort McDowell, has been discovered a large

mound, 300 x 250 feet in size, with walls of stone two feet thick surround; within and down to the depth of ten feet have been found stone implements of all descriptions, also utensils of a peculiar material, painted on the inside with Egyptian characters, ornaments of shell, needles of bone, and in fact a perfect museum of relics of the stone age, and of a race now extinct. There were also found tombs, three tiers deep, and underneath cisterns of water. The walls are made of rock found six miles from the mound. Near the quarry are found paintings of beasts of burden, including representations of the camel, and a very large animal resembling the mastodon; also, several unknown figures. The bones found in the tombs were partially destroyed by fire, and the walls showed disturbance by upheaval. This is probably the most important discovery made in Arizona.

15. Copper Bells in the Early Press

Nowhere did it seem to dawn on anyone that copper bells were a sign of the diffusion of Buddhism. They have been prized as cult and prestige objects in India, Southeast Asia, China and Japan above all places. The case for independent invention in the Americas is not a cogent one. The earliest reports of their presence among the Indians of Mexico and Arizona never seem to have gone beyond simply marveling at their sheer existence, and wondering in a childlike way at their making a tinkling sound. A voluminous literature since then has hardly added any depth of understanding. Over a hundred years after the first copper bells came to light American archeologists and anthropologists consistently deny pre-Columbian inhabitants had any true knowledge of metals or meaningful contact with Old World civilizations. Arizona Daily Star, June 1, 1911, p. 6, and June 29, 1911, p. 5.

a.

Copper Bells Are Found in Mound

Discovery Believed to Prove Ancients Had Knowledge of Metal Work

PHOENIX, Ariz., May 31.—William Lossing, living on a ranch a mile and a half west of the fair ground, has come into the fortunate possession of three copper bells, which put an entirely new aspect upon the dwellers of the Salt River valley.

They were found in the mound on the road running a mile west of the fair grounds by Walter Willa, an employe of Lossing, while extracting earth for grading, and they bear the marks of having lain in the earth for hundreds of years.

This is the first instance, so far as known, of a discovery of relics leading to a supposition that the prehistoric valley dwellers may have had a knowledge of metals.

The bells were cast: that is an unmistakable fact. They are in a way like sleigh bells, of the conventional size of such, but somewhat more elongated. Within one of them, which is perfect, save for the eating of verdigris, there remains the stone clapper, put here ages ago by not only a vanished but an unidentifiable hand. The others had similar clappers, but were damaged by

Mr. Willa's shovel in excavating.

Mr. Lossing, who is a student of ancient ways and life, is not inclined to believe the bells may have been brought from Mexico or Peru by Spaniards and dropped within the mound.

"I regard these bells as furnishing conclusive proof of the fact that the ancients of this region understood and worked metal," claims Lossing. "Those bells were buried under the entire mound; they came from the floor of what had once been one of the seven big houses, consequently the people who lived in that house, to my mind, owned the bells."

The bells show a high degree of skill in designing as well as clever methods of casting.

b.

Bells Older than Advent of Europeans

Antiquarian Reports Salt River Find Antedates White Occupation—Age is Not Found Proven

On May 20 Dwight B. Heard of Phoenix sent two copper bells, which had been dug up by Mr. Lossing on his ranch near Phoenix and bore every evidence of being relics of a prehistoric civilization, to the Smithsonian Institute [sic] in Washington, to have them examined there by the experts of the department of ethnology. The matter was referred to Charles Walcott, the secretary of the Institute, whose letter to Mr. Heard containing the report of Dr. J. Walter Fewkes was received last week and forwarded to Mr. Heard in the east, and by his direction the report was turned over to the Republican.

Dr. Fewkes, attached to the bureau of American ethnology, was peculiarly fitted to make a report on the relics, as he himself found similar bells in the southern part of Arizona, and has specialized in this department of research. The more perfect of the two bells was returned with the report by Mr. Heard's request, the other one being held for analysis. This may require some time, but the result of the analysis, naturally of great interest to the people of Arizona, will be forwarded by the secretary of the institute as soon as it is completed.

In addition to the report of Dr. Fewkes, a brief statement by Mr. William H. Holmes, head curator of anthropology, was forwarded. He wrote with reference to the construction of the bells.

"It is assumed," he said, "that objects of this class, made by the Mexicans, were, as a rule, cast in some kind of mold, at least in part, the other part being produced by hammering; but the methods have not been more than partially investigated."

The report of Dr. Fewkes follows:

"The situation of the mound as given in Mr. Heard's letter is approximately the same as one of those described in my article on the Casas Grandes or Great Houses of the Gila, and I believe it the same. This mound, situated two miles west of Phoenix, is prehistoric or at least antedates the advent of Europeans into the Gila valley.

"In my excavations in different parts of Arizona I have repeatedly found copper bells, one

or two of which closely resemble those referred to above. A specimen found at Four-Mile-Ruin (See 22nd Annual Report B.E.) is approximately the same, although much corroded; and another from a ruin on the Little Colorado is even closer in size. The latter has a human face in relief on one side. The three copper bells found at Casas Grandes are smaller than those here considered and more spherical in shape. None show as well as one of these the marks of coils. The copper bells I have found were generally buried, which implies, but does not prove age.

"Any suggestion I might make about their origin or original provenance from a microscopic examination would be speculative. I have always regarded the Arizona copper bells as made in Mexico, but aboriginal. Any chemist could by analysis determine whether the copper is native or alloyed. As related to this analysis, I may call attention to my finding a piece of float copper in Compound B of Casa Grande. (Signed) J. WALTER FEWKES.

The bells are very similar in appearance to ordinary sleigh bells, but are heavily corroded. They still have a musical quality, are made of copper, and have a tiny cobblestone inside, instead of a metal ball.

16. Aztec Metallurgy

Bancroft gives the following overview of gold and silver crafts and jewelry making. The high state of Mexican metallurgy encountered by the Spanish conquistadors presupposes a long prior knowledge of metal working and mining. Hubert Howe Bancroft, The Early American Chroniclers (San Francisco: Bancroft, 1883), pp. 28-29.

Ornamental work in gold and silver had reached a perfection which struck the Spaniards with admiration, and much of the metal obtained by them was given to native smiths to shape into models and settings. Many pieces sent to Europe were pronounced superior to what Old World artists could then produce. Birds and other animals were modelled with astonishing exactness, and furnished with movable wings, legs, and tongues. The so-called 'lost art' of casting parts of the same object of different metals was known; thus fishes were modelled with alternate scales of gold and silver. Copper and other metals were gilded by a process which would have made the fortune of a goldsmith in Europe. Furnaces, perhaps of earthen-ware, and blowpipes, are depicted on native paintings in connection with gold-working.

Although there had been but little progress in mining, yet a beginning appears to have been made to obtain metals and minerals from the solid rock, and melting, casting, hammering, and carving were in use among goldsmiths and other workers, as shown in native paintings. This is one of the strongest proofs that the Nahuas were in a progressive civilization, not at a stand-still nor retrograding, for such mining and melting methods must surely lead to the discovery of iron ere they stopped. Cutting implements were made of copper alloyed with tin, and tempered to great hardness. Yet stone tools were still chiefly used, particularly those of obsidian, from which mirrors were also made, equal in reflecting power to those of Europe at

that time, it was said. Softer stone being chiefly used, flint implements sufficed for the sculptor; yet specimens exist in hard stone. Precious stones were cut with copper tools, with the aid of a sand, and carved in forms of animals. Specimens of their art in stone and metal were received in Europe, where chroniclers of different minds and impulses write in ecstasy over workmanship which in so many instances surpassed in excellence that of Spain.

17. How the Craftsmen Who Cast Precious Metals Fashioned Wares

These extracts describe the Aztecs' expertise in the lost-wax or investment-casting process, as we would call it today. They are quoted from the Ninth Book ("The Merchants"), sixteenth chapter of Sahagún's General History of the Things of New Spain, preserved in the famous Florentine Codex. Written in Nahuatl with extensive illustrations from the 16th century, such passages show that native craftsmen were familiar with the same cast metals technology used in the Old World, and more. They customarily used metal tools and produced precision casts of gold, silver, copper and a range of metal alloys. They were especially skilled in the use of purified beeswax, which they hardened with white copal. Bernardino de Sahagún, General History of the Things of New Spain: Florentine Codex. Book 9 – The Merchants, translated from the Aztec into English, with notes and illustrations by Charles E. Dibble and Arthur J. O. Anderson, School of American Research and Museum of New Mexico Santa Fe, New Mexico, no. 14, pt. X. Salt Lake City: U of Utah P, 2012, pp. 73-78.

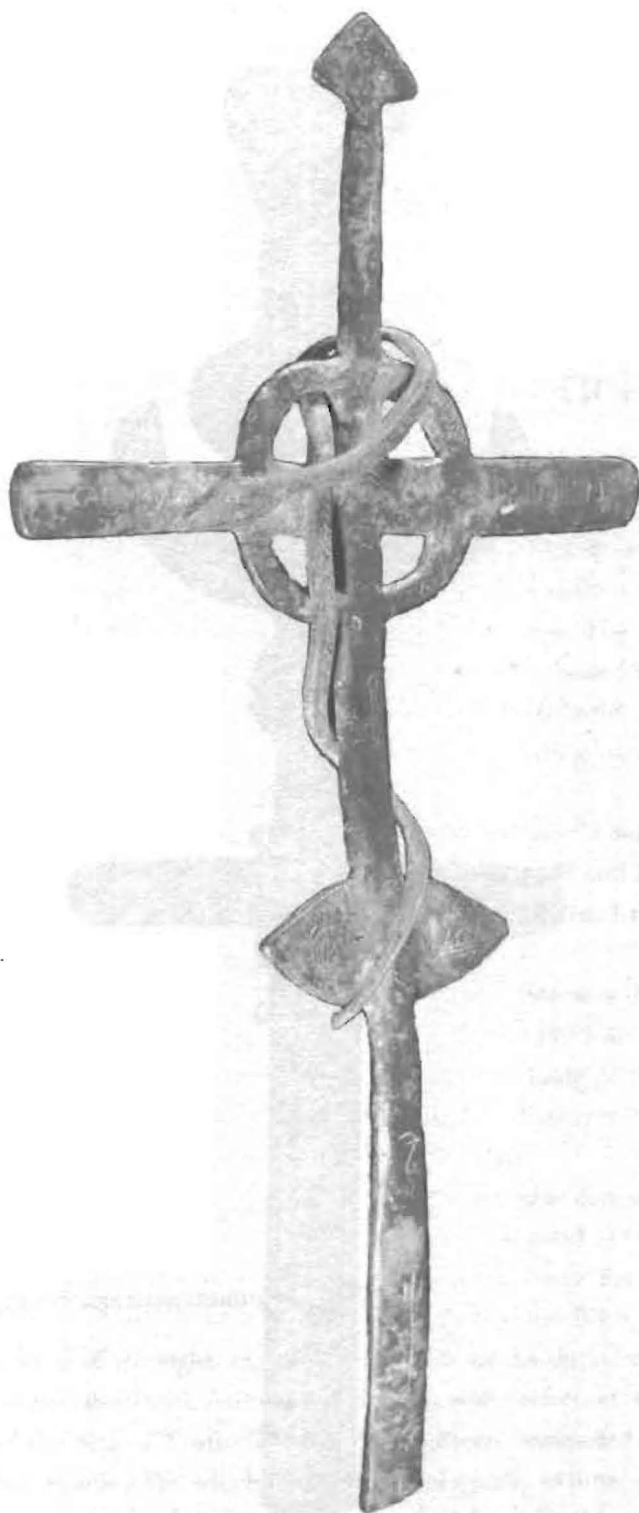
The craftsmen fashioned [and] designed objects by the use of charcoal [and clay molds] and beeswax [models] to cast gold and silver The charcoal [and clay core] was carved, sculptured, with a small metal blade.

Today the goldworkers . . . require (call for) sand – fine sand. Then they grind it, they pulverize it well; they also mix it with potter's clay

They especially esteem beeswax; they use it especially to form patterns, to produce works of art. But first, somewhere, a model of beeswax is made. When it has been well prepared, the mold is pressed upon it [to make the wax model]. For there is a model [in wax] of all they make, whether birds' wings, or flowers, or leaves of plants, or whatsoever beautiful design . . .

When it has been prepared . . . to it is placed the beeswax channel, called the round *anillotl* . . . This becomes the channel for the gold, for it to enter there

When they are this far . . . [the mold] is placed on the fire; it is thoroughly heated. Then flows out burning the beeswax [model] which has been placed within it. When the beeswax has come forth, when it has burned, then [the mold] is cooled, for which purpose it is once more set out over sand, quite coarse sand. Then immediately the casting takes place; there [the mold] enters the "fire pot" [a charcoal brazier] on a charcoal [fire]; and the gold, which is to enter there [into the mold], is melted separately in a ladle [and poured].



Calalus Nehushtan (18 obverse). Photo Robert C. Hyde.

MERCHANT ADVENTURER KINGS OF RHODA



Ten Commandments Nebushtan (20 reverse). Photo Robert C. Hyde.