

HISTORICAL GEOGRAPHY OF BISBEE, ARIZONA

by

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TABLE OF CONTENTS

	Page
LIST OF ILLUSTRATIONS	v
LIST OF TABLES	vii
ABSTRACT	viii
CHAPTER	
I. INTRODUCTION	1
II. BISBEE'S PHYSICAL ENVIRONMENT	11
Climate	12
Geology and Geomorphology	17
Vegetation	22
Hydrology	25
III. DISCOVERY AND INITIAL DEVELOPMENT, 1877-1883	30
IV. PERIOD OF GREATEST EXPANSION, 1884-1916	46
V. EVOLUTION OF MODERN BISBEE, 1917-1966	80
VI. SUMMARY AND CONCLUSION	111
APPENDIX GLOSSARY OF MINING TERMS	122
SELECTED BIBLIOGRAPHY	124

LIST OF ILLUSTRATIONS

Figure	Page
1. Bisbee's relative location in Arizona	3
2. Bisbee and the other communities of southern Cochise County	4
3. Contour map of the Bisbee area	7
4. Climatic chart showing average temperature and precipitation conditions for Bisbee .	18
5. Bisbee during the early 1880's	37
6. Mules used to distribute the town's water supply during its early years	37
7. Railroad expansion directly affecting Bisbee's development	40
8. A view of Bisbee from the east in 1884 . . .	47
9. A view of Bisbee from the west in 1884 . . .	47
10. 1889 view of the entrance to Brewery Gulch .	56
11. Brewery Gulch business district, circa 1890 .	56
12. The foundation remains of one of the early row houses in Brewery Gulch	58
13. The Copper Queen Smelter with its two smokestacks on the side of Queen Hill . .	58
14. Bisbee from the south in 1904	65
15. Bisbee, 1966	65
16. One of the many cavities on Queen Hill caused by the cave-in of underground workings .	72
17. Small fault or fissure on Queen Hill caused by sub-surface slumping	72

LIST OF ILLUSTRATIONS--Continued

	Page
18. The major underground workings beneath Queen Hill in 1902	73
19. The Bisbee area about 1920, showing the population centers, railroads, and major mines	81
20. The dashed line delineates the depression where Sacramento Pit once was	88
21. The Lavender Pit, 1964	88
22. Schematic diagram of the extraction and concentration procedures of the Lavender Pit and Concentrater	92
23. A small check-dam near the head of Brewery Gulch	99
24. Houses being torn down to make way for the westward extension of the Lavender Pit	99
25. Street pattern of the Bisbee townsite at its greatest extent, circa 1925	101
26. Houses on Chihuahua in 1916	104
27. A different view of the same hill in 1966 with only the stone foundations remaining	104
28. Past and present boundaries of the Bisbee central business district	105
29. Boundaries of the present City of Bisbee	109
30. Mining property ownership in 1902	116
31. Mining property ownership in 1923	117
32. Mining property ownership in 1948	118

LIST OF TABLES

Table	Page
I. Bisbee Temperatures 1895-1953	16
II. Yearly Moisture Totals 1890-1953	16
III. Production of the Copper Queen Company . . .	39

ABSTRACT

The historical geography of Bisbee is divided into three principal periods based on the growth of the mineral production, the development of routes of transportation, and the urban evolution which accompanied these. The first period, 1877 to 1883, concerns the initial discovery of copper ore in the area and the subsequent small-scale development. The second, 1884 to 1916, deals with the most expansive era in the history of the area. Bisbee was transformed from a little-known mining camp to one of the West's foremost copper producers. The population grew from a few hundred to almost twenty thousand. The final period, 1917 to 1966, represents a profound change in the area. The emphasis in mining changed from underground workings to open-pit. Associated with this was a decline in the population, leading to the gradual stagnation of the Bisbee townsite.

Of major emphasis throughout the study is the effect man has had on the natural landscape. The most noticeable changes concern the vegetation and the landforms, both of which have been considerably altered as the area's mineral resources were exploited.

CHAPTER I

INTRODUCTION

The historical geography of Bisbee has evolved out of man's need for copper, in fact, Bisbee owes its very being to that industry. As the fortunes of the copper companies rose and fell, so did those of Bisbee. New ore discoveries and higher copper prices brought people into the region while the exhaustion of known reserves and the lowering of prices forced people out. In addition to copper, other minerals, notably gold and silver, have had a cumulative importance to this area. Unlike its neighbor, Tombstone, Bisbee never had a "rush" associated with the two latter minerals. Their importance has resulted from a gradual accumulation which enabled the Bisbee district to become the leading total producer of gold and silver in Arizona (Wilson, 1962, p. 109). The change wrought upon the landscape by mining activity constitutes an important segment of the historical geography of the Bisbee area.

As a general rule, the term "Bisbee," in this study, refers not only to the original townsite, but to the entire district. The district includes Bisbee, the communities of Warren, Lowell, Huachuca Terrace, and Don Luis, as well as the smaller subdivisions which are part of

the larger communities. The terms "Bisbee area" and "Bisbee region" are synonymous with "Bisbee district." Also referring to this same general area, but with specific reference to mining activities, is the term "Warren mining district," named after one of the early prospectors. When special reference is made to the original townsite of Bisbee, it will be designated as such, or called "the town of Bisbee."

Bisbee is located in the southeastern portion of Arizona (Figure 1), seven miles from the International border and fifty-five miles from the Arizona-New Mexico state line. Figure 2 illustrates Bisbee's position in Cochise County and its position relative to the other urban areas in the southern part of that county. Douglas, twenty-four miles to the southeast, is Bisbee's closest neighbor, and it is the largest town in the area, with a population of approximately 12,000. Other towns are Benson and Tombstone, to the northeast, with populations of 2500 and 1100, Sierra Vista to the west, population 4500, and to the south, Naco, having a population of a few hundred. Today, the city of Bisbee has a combined population of 9200.

The original townsite of Bisbee is situated in an erosional corridor through the Mule Mountains, with Mule Gulch and Tombstone Canyon respectively forming the east and northwest portions. Bisbee, on the lower slopes and

Figure 1. Bisbee's relative location in Arizona

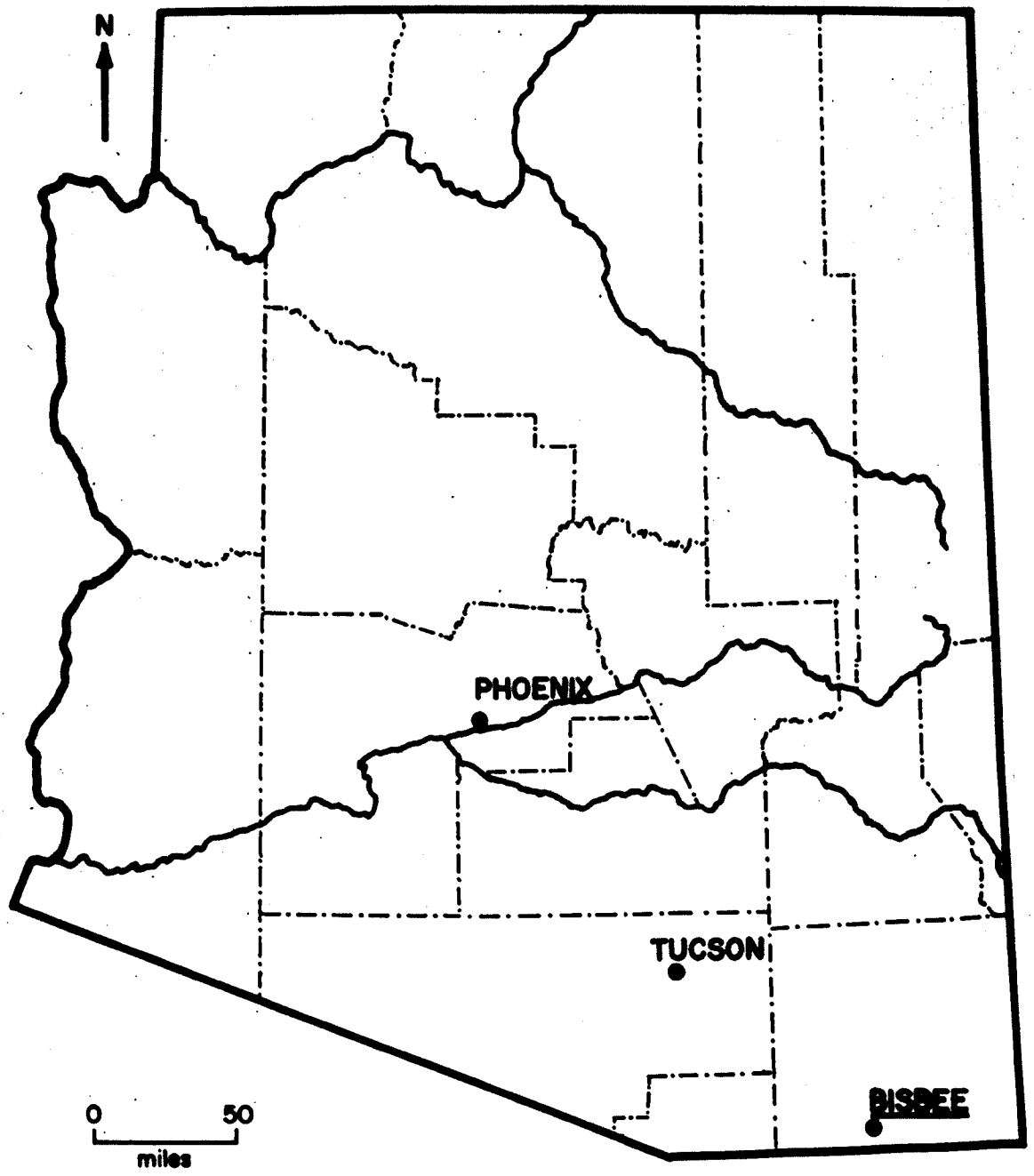


FIGURE: 1

Figure 2. Bisbee and the other communities of southern Cochise County.

Source: U. S. Geodetic Survey Washington, D. C., 1962, Arizona, U. S.-Mexico: 1:250,000, Nogales N H 12-2 Douglas N H 12-3

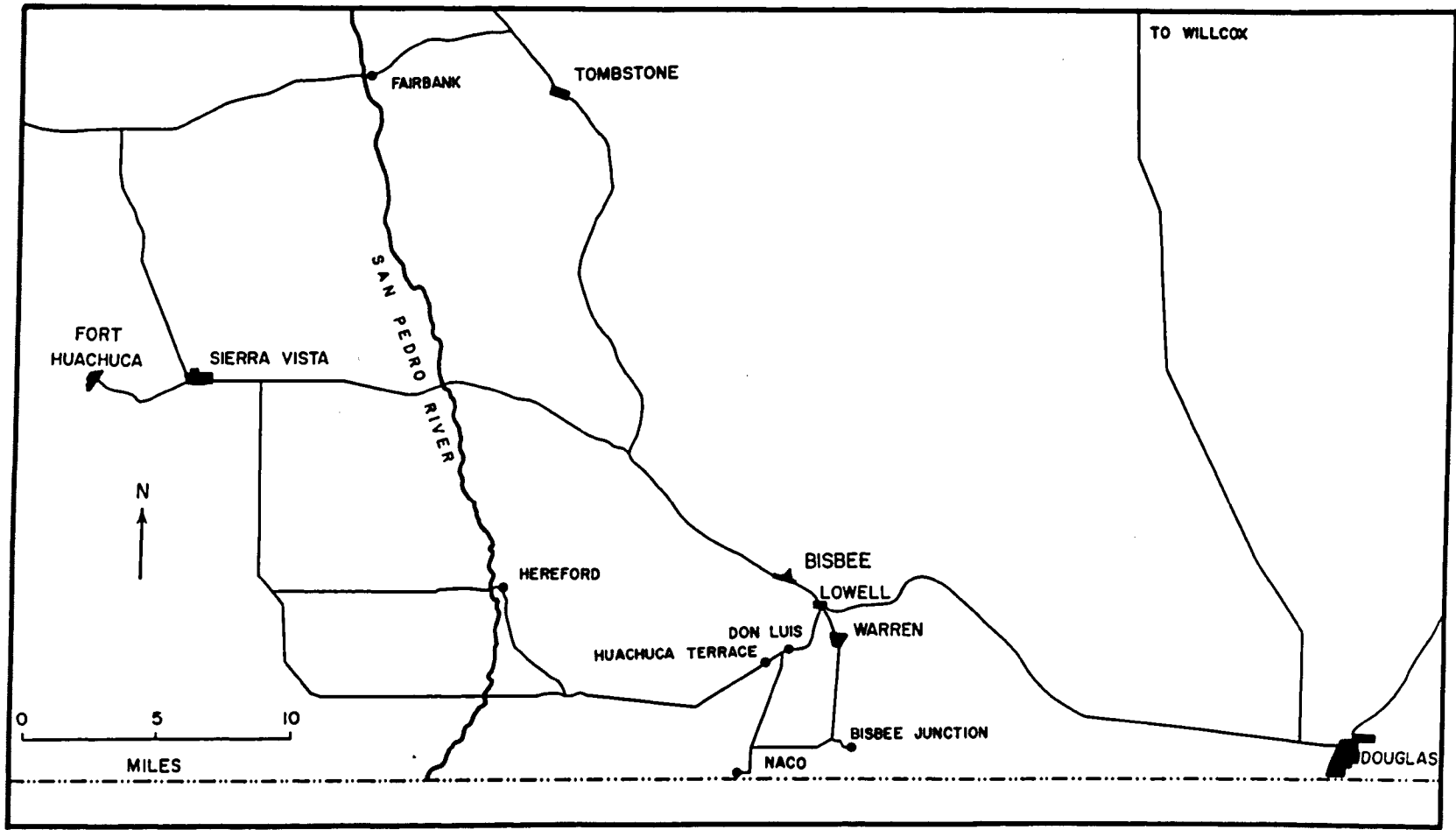


FIGURE 2

bottom of the corridor, has an elevation of 5300 feet, while the surrounding hills have elevations up to and exceeding 7000 feet. The height and steepness of the hills has served to effectively wall-in Bisbee, forcing it to expand up the hillsides, producing a distinctive settlement pattern.

The community of Warren, on relatively level land two miles to the southeast, was planned from the beginning as a residential district. It was laid out to fit the wedge-shaped alluvial plain it occupies, which accounts for its peculiar shape. The southernmost communities of the area, Huachuca Terrace and Don Luis, are also on relatively flat land. Don Luis is the older of the two; it was first settled around 1900, when it served as a railroad junction. Huachuca Terrace is a modern subdivision, constructed within the last ten years.

Bisbee has existed as a town since 1880, and through all this time it has been more or less dominated by various copper companies. In the early years there were many small ones, but as time passed, the size of the companies increased as their number decreased. Since 1948, the area has been dependent on one, Phelps-Dodge, for its livelihood. With its economic base so thoroughly controlled by this one company, it is possible that Bisbee's growth and development might have been considerably different had it not been so completely company-controlled. The

placement and ownership of its houses, the peculiar shape of its city boundaries, and the changeable characteristics of its population have all been directly influenced by the company. Each of these, and other such information, will be discussed in the final chapters.

The particular type of geographic method used in this study, as indicated by the title, is historical. This does not mean that it will provide the reader with a recapitulation of the history of the area; neither does it mean to explain the historical events as determined by the prevailing geographic conditions; but, rather, its purpose is to present an insight into the past geography of the area. Geography can often "provide a key to . . . many environmental relationships that have persisted after the occasion for them has passed" (Barrows, 1911, p. 11). The basic difference between a study of the historical geography of an area, and one of its history depends on the objectives of the writer. If this basic objective is to gain an understanding of areal differences as conditioned by time, then the study belongs in historical geography. If, on the other hand, the basic objective is a better understanding of chronological changes or events, the study is historical, regardless of the amount of geography involved (James, 1948, p. 272).

Unstead (1922, p. 57) suggests that such change may be examined in four possible ways: (1) changes in the

Figure 3. Contour map of the Bisbee area
Source: U. S. Geological Survey, Washington, D. C., 1958.
N.W. 1/4 Bisbee, Arizona, 1:24,000

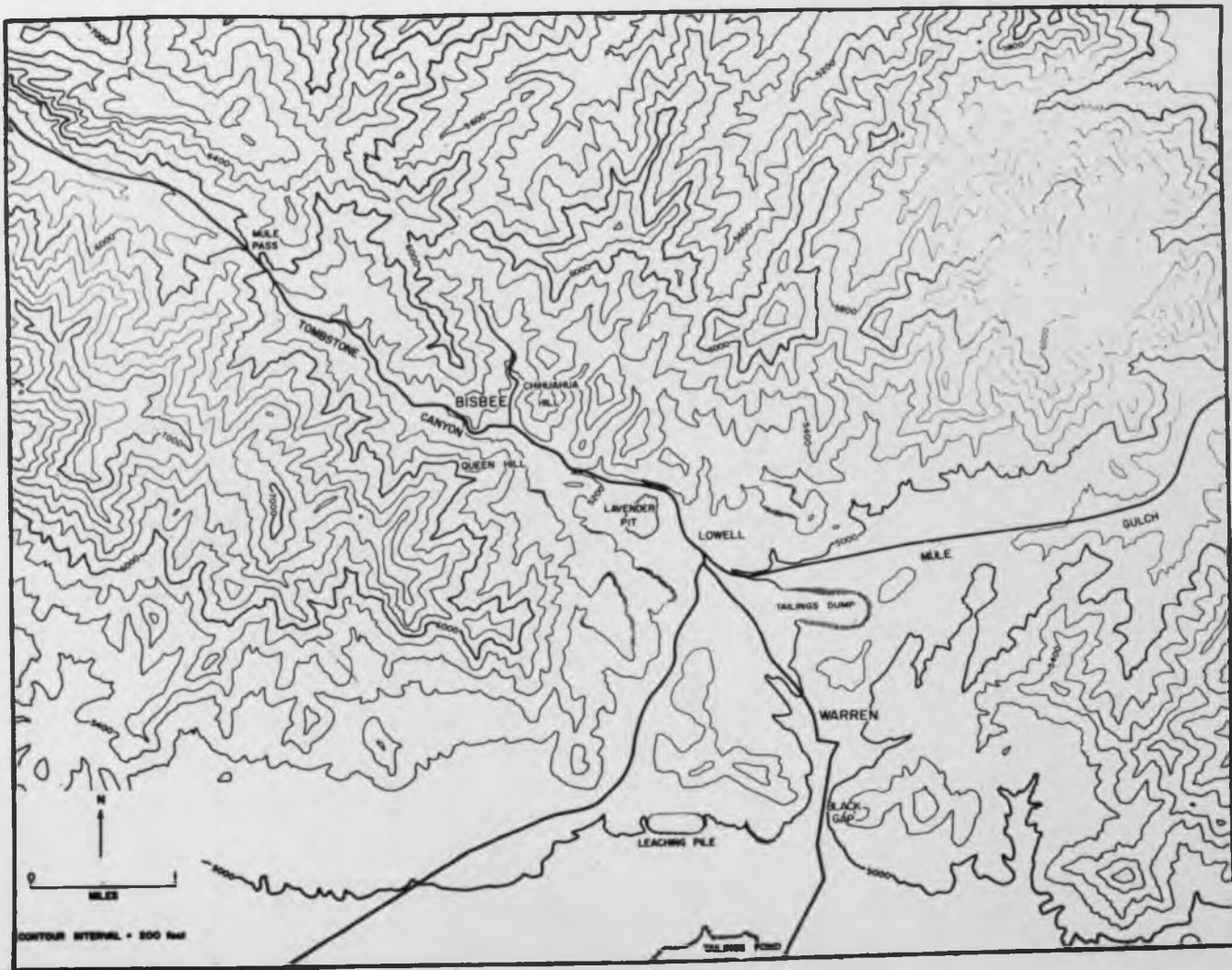


FIGURE 3

physical conditions due to natural processes; (2) changes due to the intentional or unintentional action of man; (3) changes in the relation of one region to another as, for instance, the opening or closing of routes of transportation; and (4) changes in the utilization of the resources of a region by its inhabitants. Each of these, but in particular the last three, will be dealt with in depth as the past geography of the Bisbee area is discussed. In order to accomplish this, there are three principal avenues of concentration: the historical progression of the mining activities and their effect on the landscape; the development of transportation routes; and the changing settlement patterns of the area. While these do not completely cover the historical geography of Bisbee, they are of interest, and present a representative picture of that area.

Although the natural environment exerts an influence, man has been most successful in transforming it to fit his needs. In few places is this more clearly illustrated than in Bisbee; for here not only has the character of the surface been greatly changed, but also that beneath the surface. Many hundreds of miles of tunnels, stopes, and shafts have transformed the once solid-rock hills into a man-made, underground, cultural "landscape"; while above ground, hills have been removed, gullies filled, and slopes deforested.

A study of the historical geography of an area may be approached in different ways. For example, Ralph Brown in Mirror for Americans (1943) preferred to use the historical cross-section approach. In it he attempted to recreate the geography of the Eastern Seaboard as it appeared in 1810. Other studies using this approach have taken multiple cross-sections from different time periods and attempted to show the connection and progression between each.

Another approach is that of sequent occupance. This refers to the successive patterns of settlement impressed upon a given physical environment by a succession of different people with differing economic techniques (James, 1948, p. 274). This approach concerns itself with the way each successive group regards the land and how each utilizes it. W. A. Rodgers' unpublished thesis, Historical Land Occupance of the Upper San Pedro River Valley Since 1870 (1965) is an example of such an approach. He was able to show how land usage was changed as each successive group became dominant.

The method used in this study involves the illustration of the historical progression through which the landscape has evolved. This approach differs from that of sequent occupance in that the latter views the changing land patterns through the eyes of the people doing the changing, while the principal emphasis of the former is on

the actual changing landscape itself, rather than on the people that change it; the people, while important, are secondary.

CHAPTER II

BISBEE'S PHYSICAL ENVIRONMENT

Four general features of Bisbee's physical environment are discussed in this chapter: climate, geology and geomorphology, vegetation, and hydrology. These elements are described as they are thought to have been before the first miners came to the area. There are other elements of the physical environment not mentioned here, but those listed are, from the point of view of this study, the most important to the Bisbee area, because they are pertinent to an understanding of the conditions by which the land was changed. Climate is important because it greatly influences the area's suitability for habitation. The geology or rock formations are of significance in so far as they have determined topographic features and mineral resources. The distribution of natural vegetation types is a consistent indicator of change; particularly change incurred by human activity. Finally, hydrology is included because the supply of both surface and groundwater has been a critical factor in the development of this region. With the exception of climate, which is relatively stable, each of these physical elements has been modified in the Bisbee area. In the

chapters that follow mention will be made how these have been changed, and to what degree.

Climate

The climate of Bisbee offers no marked exceptions to the general aridity of the Southwest. Throughout most of this area the general climatic characteristics are uniform: potential evaporation is greater than precipitation; cloudiness and the relative humidity are low; diurnal and annual temperature ranges are large; and the small amount of precipitation falls sporadically throughout the year. Each of these will be discussed in general, followed by a more detailed treatment regarding their effects on Bisbee's climate.

The Southwest owes its arid condition primarily to the presence of a subtropical belt of high pressure that encircles the earth at approximately thirty degrees latitude. Throughout this belt, subsidence characterizes the overall movement of air, effectively limiting the amount of precipitation. A secondary aridity factor is the rainshadow effect. The various mountain ranges of Southern and Baja California block much of the precipitation carried by west winds blowing off the Pacific Ocean. The severity of this rainshadowing is witnessed by the extreme aridity of the Colorado and Mojave Deserts.

The precipitation that does occur in the Southwest comes during two opposite times of the year, mid-summer and mid-winter. That of the latter results from eastern-bound cyclonic storms originating in the Pacific Ocean. Most of these storms pass to the north of Arizona because they are forced to skirt a semi-permanent ridge of high-pressure off the coast (Thorntwaite, 1942, p. 4). When Arizona, and particularly southern Arizona, receives an abundant supply of winter precipitation, it usually means that the high-pressure ridge has been displaced by a low-pressure trough (Sellers, 1960, p. 23). Each individual storm is usually fast-moving and passes through an area in a day or two, but, because of the displacement, a succession of these storms may occur, producing a rainy period of a week or two in length. Winter precipitation is usually of lighter intensity and falls at a more steady rate than that occurring in summer. The reason for this is that the causes of the summer precipitation are altogether different.

Summer moisture comes mainly from the Gulf of Mexico with a small additional amount originating in the Gulf of California (Ibid., p. 17). A thermal low created by the heating of the land surface tends to draw moist air into the Southwest, with the areas nearest the Gulf of Mexico receiving the most rain and western areas less. This precipitation is in the form of thundershowers, which are usually of high intensity and short duration.

Mid-afternoon is the most frequent time of occurrence, when the land is at its hottest. According to the available figures, most places in southern Arizona, including Bisbee, receive over seventy percent of their precipitation during the summer half of the year, May through October (Smith, 1956, p. 11).

The annual temperature range of the area under discussion is large. Its position in the interior, removed from the moderating effect of any large water body, greatly affects this range. The diurnal temperature ranges are also high owing to the clear skies and to the relatively small water-vapor content of the air. Both factors permit a large amount of solar radiation to reach the ground in daytime, and a similarly large amount of terrestrial radiation to be lost to space at night (Haurwitz and Austin, 1944, p. 204). A further reason for large diurnal variation arises because a large portion of the ground supports little vegetation, causing the soil to become much hotter during the day than it would if it were completely covered by vegetation.

The climatic regime of Bisbee is generally similar to that of other areas in the Southwest; however, local conditions are responsible for some differences. Both the annual and diurnal temperature ranges are less extreme than other places in the Southwest. Sellers (1960, p. 23) attributes the smaller diurnal range to Bisbee's hillside

location. The cold air that drains down the mountains in the early morning does not settle in the town, but continues toward the lower valley floor. Altitude plays an important part in the smaller annual temperature range found in Bisbee. At 5300 feet, it has much cooler summer temperatures than surrounding areas that have lower elevations (Ibid.).

Table I indicates that the coldest month in Bisbee is January, with an average high of 69.8° and an average low of 22.4°. The warmest month is July, with 97.1° as the average high and 58.3° the average low. The highest temperature ever recorded, 106°, occurred in June, while the lowest, 8°, occurred in January. With maximum summer temperatures that usually stay below 100°, Bisbee enjoys an enviable position compared with other towns of the area at lower elevations. During the winter, the temperatures are less extreme than those found in neighboring towns. Benson, sixty miles from Bisbee, is 1800 feet lower in elevation, and has an average January low of 16.8°, nearly 4° colder than Bisbee's (Smith, 1960, p. 21).

As in the whole of the Southwest, Bisbee receives its precipitation mainly during two seasons, mid-summer and mid-winter (Table II). Seventy percent of the yearly average total of eighteen inches falls during the six warm months, May through October. July and August are the rainiest months with 3.96 and 4.41 inches respectively,

TABLE I
BISBEE TEMPERATURES 1895-1953*

Month	Average High (°F)	Average Low	Mean Max.	Mean Min.
Jan.	69.8°	22.4	57.5	34.3
Feb.	72.6	24.8	60.9	36.5
March	77.9	28.9	66.1	40.4
April	83.5	34.7	73.7	45.2
May	90.4	41.2	81.2	53.2
June	98.3	51.0	90.0	62.1
July	97.1	58.3	87.2	64.2
Aug.	93.6	56.9	86.5	62.5
Sept.	91.8	50.7	84.2	59.0
Oct.	85.6	39.1	76.2	50.3
Nov.	77.1	29.8	65.8	40.0
Dec.	70.0	24.3	58.0	35.3

*Smith, 1956, pp. 21, 36

TABLE II
YEARLY MOISTURE TOTALS 1890-1953*

Month	Average Precip. (inches)	Snow Total	6:00 hr. Mean Rel.	18:00 hr. Hum. %
Jan.	1.20	3.6	49	32
Feb.	1.28	2.3	52	32
March	0.70	1.3	46	26
April	0.51	0.3	42	22
May	0.22	0.0	38	21
June	0.64	0.0	40	25
July	3.96	0.0	59	42
Aug.	4.41	0.0	68	46
Sept.	2.00	0.0	62	42
Oct.	1.00	0.0	57	39
Nov.	0.85	0.6	47	30
Dec.	1.33	2.1	53	34
Year	18.00	10.2	51	33

*Smith, 1956, p. 11

forming over forty-five percent of the annual total.

Bisbee's location on the south slopes of the Mule Mountains greatly enhances its chance of receiving its share of summer precipitation. Moisture-laden air coming from the Gulf of Mexico cools as it rises over the mountains and as a result Bisbee receives four more inches of rain than does Douglas which is only twenty-three miles away but situated on level ground.

Winter precipitation is somewhat less than that of summer. December, January, and February receive the most winter precipitation: the first of these getting approximately one and a half inches. Some of the winter precipitation falls as snow, but this totals only ten inches a year. Table II presents Bisbee moisture receipts in more detail.

Geology and Geomorphology

The Mule Mountains are one of the smaller of the isolated ranges characteristic of southern Arizona. According to Wilson (1962, pp. 86-87) the Mule Mountains are part of the Basin and Range Province. While less linear than the Dragoons, Huachucas, Chiricahuas, and other neighboring ranges, the Mules have the general northwest-southeast trend so common throughout the Basin and Range country. The southernmost terminus of the Mule Mountains is near the International Border, where they consist of low

Figure 4. Climatic chart showing average temperature and precipitation conditions for Bisbee.

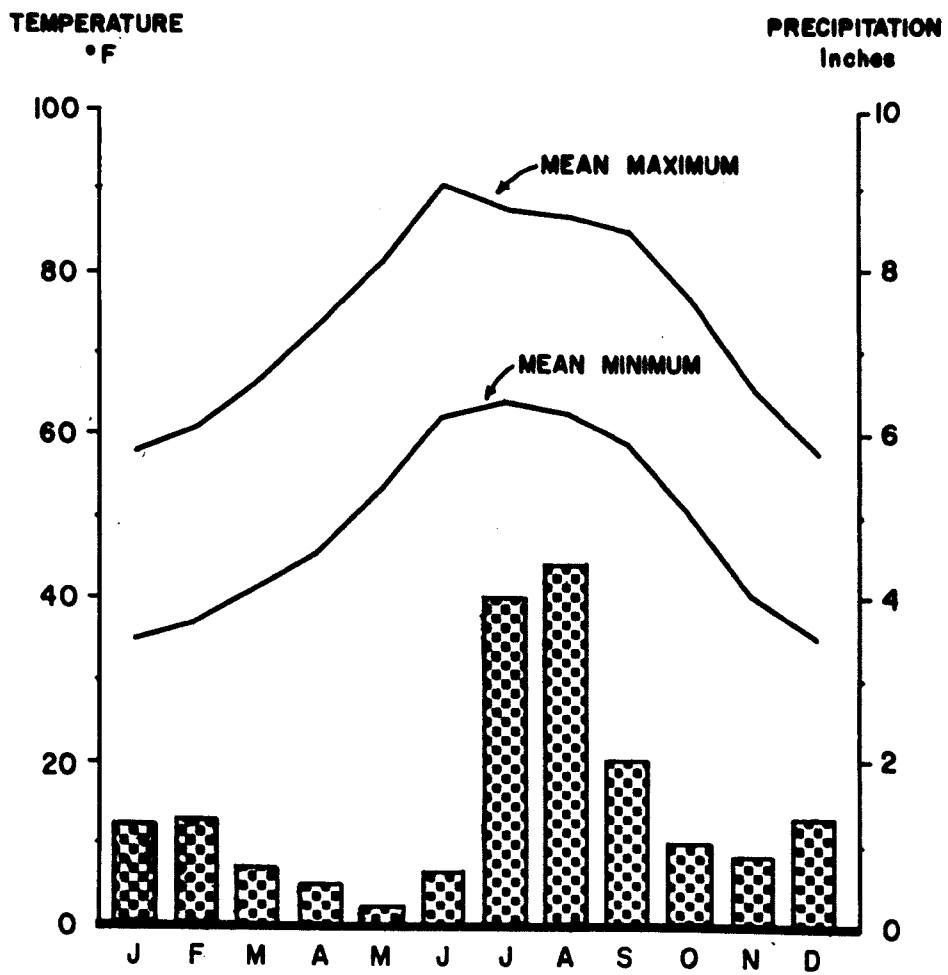


FIGURE 4

hills one or two miles wide. These hills extend for about three miles to the northwest. At this point there is an abrupt rise caused by the Gold Hill overthrust fault (Bonillas, 1916, p. 286); beyond the fault the range widens and becomes more rugged. The highest point, Mount Ballard (7370 feet), is about nine miles northwest of this fault. Government Draw, a pass two miles in width, connects the Sulphur Spring and San Pedro Valleys, marking the end of the range. The total length of the Mule Mountains is approximately twenty-three miles; the maximum width, about ten miles, is opposite Bisbee. Beyond Government Draw the Tombstone Hills commence.

On their northeast side the Mule Mountains present a fairly straight front, with slopes rising steeply from the southwestern margin of Sulphur Spring Valley. On the southwest the line separating the mountains from the San Pedro Valley is sinuous. Penetrating the mountain front at irregular intervals are the broad embayments of alluvial plains. These coalesce to form the Espinal Plain which slopes to the southwest to join the San Pedro Valley.

Geologically the Mule Mountains are divided into two divisions by the Dividend Fault (Trischka, 1938, p. 33). The surface expression of this fault is the eroded depression of Tombstone Canyon and Mule Gulch. Northeast of this line the mountains are sculptured from Cretaceous rocks. Southwest of the fault pre-Cretaceous or Paleozoic rocks

prevail. The difference in the two tracts is marked, physiographically. North of the fault, the rock materials are uniformly soft, consisting of sandstones, shales, and conglomerates, which are little faulted. The topography carved from them is characterized by gently sloping hills and draws, with almost no steep cliffs or deep valleys (Ransome, 1904, p. 19). From a distance, this area resembles a flat tableland, dipping gently toward the north. The older, pre-Cretaceous tract, south of the fault, consists of rock materials of diverse composition and unequal hardness, such as schist, shale, granite, and limestone. This factor, in addition to the longer time they have been subjected to erosion, has formed a rugged, unequal topography with deep canyons and sheer cliffs (Ibid.). The color of the two tracts is not the same; because of a preponderance of limestone, the area to the south is characterized by a homogeneous gray. To the north the color is less uniform, varying from the deep red of Chihuahua Hill, directly north of the fault, to the lighter pinks and browns of the hills farther north.

Ransome divided the Bisbee area into seven structural blocks (Ibid., pp. 93-94), each of which is separated by one or more faults. These blocks are the Bisbee, Escabrosa, Naco, Copper Queen, Gold Hill, Glance, and Cretaceous. Of these, the Copper Queen is the most important to this discussion, because it contains many of

the copper deposits. It is part of a canoe-shaped syncline of Paleozoic rocks and is downthrown 3,000 to 5,000 feet, with respect to the Bisbee Block. These two blocks are separated by the Quarry and Dividend faults (Trischka, 1938, p. 33).

The stage for mineralization was set during Carboniferous times, when a deep-seated laccolith first domed the strata as it pushed upwards, and then became a volcano as the overlying strata finally gave way. The rhyolite that flowed from the volcano gradually cooled, and as it did, it changed into a granite porphyry. Dikes and sills of porphyry shot out into and along openings and breaks in the rocks, preparing the way for the mineralization which was to follow (Trischka, 1931, p. 501). The mineralizing solutions first appeared during the Cretaceous. It appears that there were several distinct periods of mineralization, and that each period was composed of waves of varying mineral content, strength, and intensity (Trischka, Interview). The solutions ascended the core of the old volcano and filtered out along many of the cracks and openings in the surrounding limestone. The copper minerals in the solutions replaced some of the minerals in the limestone and also in the porphyry. The highest grade ore is found where the limestone was replaced, but the greatest area of ore is found in the East and West orebodies which are the remains of the old porphyry stock; however, in these

deposits the ore is not of high quality, being disseminated throughout a large area (Trischka, Interview).

The first discovery of copper in the district was made in an open cut on the hillside above the present Post Office. It was one of the two outcroppings of copper ore in the area. The ore here was malachite and azurite, which, for the first decade, was the only ore that was mined to any great extent in the district (Ibid.). As work progressed, the miners were forced to use ore that had lower percentages of copper, until today, a large amount of the ore comes from the secondarily enriched deposits of the Lavender Pit, where the ore averages 0.75% copper.

Secondary enrichment refers to a leaching process in which groundwater percolates through low-grade, disseminated ores near the surface, dissolving some of the copper; at a lower level the copper is redeposited, enriching the ores at that level (Ibid.). In Bisbee the top of this lower level begins about 200 feet from the surface. It is only in recent years that advanced recovery techniques have enabled the copper companies to utilize these deposits.

Vegetation

The vegetation of the Bisbee area today is quite different from what it was before the early miners first settled there. The original vegetation consisted of a thick cover of protective grasses, bushes, and small to

medium size trees. A discussion of the present vegetation is important, not so much because of the plants which are present, but to show how the original vegetation was modified by man. Such a discussion is included in subsequent chapters where it can best be tied-in with the conditions producing the changes. The present summary treats only the original or pre-mining vegetation to provide a basis for future reference and comparison.

The alluvial apron of Espinal plain comprising the southern portion of the area has the lowest elevations. It had the typical grassland association found in southern Arizona at comparable elevations (3,000 to 5,000 feet). Grass is favored at these lower elevations because the rainfall is usually not sufficient to support trees. Grass is also readily attracted to deep, well-drained alluvial soils present here. The Espinal Plain had a rich mixture of different grasses; the most abundant were black grama (Bouteloua eriopoda), beard (Andropogon spp.), curly mesquite (Hilaria Belangeri), and tobosa (Hilaria mutica). In addition to grasses, yucca (Yucca spp.), cat claw (Acacia Greggii), Mormon tea (Ephedra trifurcia), and false mesquite (Calliandra eriophylla) were also present but in fewer numbers (Benson and Darrow, 1944, p. 28 and Darrow, 1944, p. 334).

The higher elevations of the Bisbee district supported a mixture of oak-woodland and chaparral. The

rainfall was not sufficient to support a true forest type, so that which prevailed was semi-xerophytic. Predominant among this type of vegetation were the different oaks, Emory (Quercus Emoryi), Mexican blue (Quercus oblongifolia), Arizona (Quercus arizonica), and silverleaf (Quercus hypoleucoides). Other larger trees were alligator juniper (Juniperus pachyphloea), one-seed juniper (Juniperus monosperma), Arizona madrone (Arbutus arizonica), Chihuahua (Pinus leiophylla) and Mexican Pinyon (Pinus cimbroides) pine, and Arizona cypress (Cupressus arizonica) (Darrow, 1944, p. 331). The smaller chaparral varieties were principally manzanita (Arctostaphylos pungens), and mountain mahogany (Cercocarpus spp.), with a small number of sumac (Schmattzia spp.), buckthorn (Rhamnus crocea), and Toumey oak (Quercus Toumeyi) (Ibid., p. 333). Ransome (1904, p. 17) stated that there was an abundant supply of large junipers and oaks, particularly on Juniper Flats and along the top of Escabrosa Ridge. Larger trees such as these were subject to such a demand for use in the mines that they were not long left undisturbed.

Usually separated from the trees mentioned, were the moisture-loving varieties. These were found along the principal streams and canyon bottoms. Representative of this type were Arizona sycamore (Plantanus Wrightii), Arizona ash (Frayinus velutina), Arizona walnut (Juglans rupestris), and box elder (Acer negundo). Along some

water-courses these were distinctive enough to be classed as a riparian formation (Ibid., p. 330).

In addition to trees there was an abundant supply of grass at the higher elevations. The most common types were the bunch grasses: beard (Andropogon spp.), side-oats grama (Bouteloua curtispindula), deer (Muhlenbergia rigens), and bull grass (Muhlenbergia Emersleyi) (Ibid.). Grass grew well because the trees usually were widely spaced, due to the limited moisture conditions, allowing the sunlight to penetrate.

Hydrology

The drainage of the Mule Mountains is divided between two river systems. To the southwest is the northward-flowing San Pedro River, whose waters reach the Gulf of California via the Gila and Colorado Rivers. To the east is the Sulphur Spring Valley and the southward-flowing Whitewater Draw. Its course crosses the International Boundary into Sonora, Mexico, there emptying into the Yaqui River which flows into the Gulf of Mexico. Most of the runoff of the Bisbee area converges on Tombstone Canyon and Mule Gulch which empty east into Whitewater Draw. A much smaller share of the runoff, that from the southern area of Huachuca Terrace and Don Luis, flows south and then west to empty into the San Pedro. Whitewater Draw is a true intermittent stream, flowing only during and shortly

after each downpour. The San Pedro is an interrupted stream; in places water flows all year, while in other places, water flows only intermittently.

The annual precipitation of the Mule Mountains, about nineteen inches annually, is insufficient to maintain a thick, protective vegetative cover. As a consequence, much of the rainfall does not percolate into the soil to become part of the water table, but is lost as runoff to the major valleys. Most of the water absorbed by the soil is lost to the atmosphere either by evaporation or by plant transpiration; little reaches the water table (Coates and Cushman, 1955, p. 25). The seasonal distribution and sporadic occurrence of the rainfall further decrease the amount of moisture available to the water table. Most of the precipitation comes during the summer when the vegetation is parched and brown, leaving the ground exposed. This, along with the concentrated amounts associated with cloudbursts, causes the magnitude of the runoff to be greatly exaggerated, leaving little moisture to replenish the water table.

Thousands of small gullies and rills are formed as the runoff makes its way down the hillsides. Each small channel empties into a larger one, until the largest reach the valley floor. At the break in slope of the mountain front, the confines of the channel are left behind and the velocity of the water is greatly reduced as it spreads out

to form sheetwash. This decrease in velocity forces the water to relinquish much of its load of suspended materials. Rain after rain and year after year the depth and horizontal extent of alluvial fill increases until finally the whole of the valley floor is covered (Ibid.). The Sulphur Spring Valley, for example, has, in places, more than 2800 feet of unconsolidated detritus covering the original bedrock of the valley floor (Ibid., p. 1). Unless the runoff is the product of an unusually prolonged shower, which seldom happens, it soon sinks out of sight through the porous alluvium. Thus, much of the recharge to the groundwater reservoir of the valley-fill occurs near the mountains, where it quickly reaches a sufficient depth below the zone of capillarity and root growth to eliminate losses by evaporation and transpiration (Meinzer and Kelton, 1913, p. 115).

It is probable that sometime during recent geologic history the drainage from Tombstone Canyon flowed south through Black Gap, across the Espinal Plain, and into the San Pedro River (Ransome, 1904, p. 23). With continued deposition of alluvium the gradient of Espinal Plain was gradually reduced, inhibiting its powers of headward erosion. This enabled opposite-flowing Mule Gulch to increase its headward erosion relative to the streams flowing across Espinal Plain, and to finally pirate the waters from Tombstone Canyon causing them to change course

and discharge into Whitewater Draw (Ibid.). As a consequence of this action, Tombstone Canyon and its tributaries were able to deepen and extend their courses.

Since its founding, Bisbee has been plagued with an uneven supply of ground water. During the dry periods of the year, water is in exceedingly short supply. In early days when a smelter was located in Bisbee, it was occasionally shut-down, due to the lack of water to supply the water-jacket coolers. The rapid influx of people into the area at the turn of the century completely over-taxed the water supply, which was derived from shallow wells in the bottom of the gorges (Meinzer and Kelton, 1913, p. 115), or from a few springs drained into a tank and distributed by burros (Bisbee Daily Review, August 3, 1931). The town fathers were forced to develop a well near Naco and pipe the water some eight or nine miles to the hills above Bisbee where it was stored in tanks (Ibid.).

During the rainy periods, particularly in mid-summer, the situation is reversed, and there is plenty of water in the area--in fact, at times there is too much. A large number of floods have occurred in Bisbee; some of those were most severe (Toles, 1964, p. 24). It was not until a large drainage ditch was built extending the entire length of Tombstone Canyon, that the town became safe from disastrous floods. Not only do flooding and over-abundant rains affect the town itself, but they also affect the

mines and their operations. Mention is made in later chapters of the effects of both the shortage and overabundance of the water supply in the area.

CHAPTER III

DISCOVERY AND INITIAL DEVELOPMENT 1877-1883

Unlike Ajo, Tubac, and many other mining towns of the southwest, there is no record of Indian or Spanish mining in Bisbee. McClintock (1916, p. 424) states that except for some occasional scouting parties and a few smugglers, the locality was little known and its mineral resources unsuspected before 1877. In his Handbook to Arizona (1878), Hinton barely mentions this area: "The surrounding mountains are full of mineral(s). Several rich discoveries have just been made, both in the Huachucas and the Mule Mountains. One lead shows over seventy per-cent copper, and is very rich in silver" (p. 236). Another writer, Hodge (1877), who travelled extensively in Arizona in 1874-76, makes no mention whatever of the Mule Mountains, indicating their unimportance at that time.

The man usually given credit for the discovery of ore in the Bisbee district was an army scout, Jack Dunn. He and other soldiers from Fort Bowie, on the trail of an elusive band of Apaches, camped at a mineralized spring at the east end of Mule Gulch. The water tasted so bad that Dunn set off up the Gulch in search of a more potable supply. At Castle Rock, one-half mile west of the present

business district, he found a fresh spring. Returning to tell the others, he spotted an interesting outcrop of rust-colored rock on the south side of the canyon. It is not known whether he knew what minerals the outcrop contained, but for some reason it appealed to him, and he brought it to the attention of his commanding officer, Lt. Rucker, and another friend. They made a more thorough inspection and decided to file a claim, which they called the "Rucker," after the officer. The date was August 2, 1877 (Copper Queen Bulletin, June, 1922, p. 7).

There has been disagreement over the type of ore first discovered by Dunn. Three possible varieties have been suggested: copper, lead carbonate, and silver. Many writers indicate that it was a copper-bearing outcrop because one of the two copper outcrops in the district was found near the original discovery. It is probable that copper is the most common answer given, because many writers have never seriously considered this question, or are not cognizant that there are any grounds for question; they assume that because the area is noted for copper production, the original discovery was also copper. In many other articles, the ore-type is not mentioned, leaving the reader to draw his own conclusions. No reliable evidence has been found that would substantiate a copper discovery.

Two individuals, James Douglas and Carl Trischka, well-acquainted with the geology of the area, feel that the original deposit probably was not copper but cerrusite, a lead carbonate mineral. Douglas (1899, p. 511) states, "in fact, it was a small deposit, not of copper ore, but of cerrusite, which still remains undeveloped, on the western side of Queen Hill, which first tempted miners to the spot." Trischka (Interview) also suspects that cerrusite, rather than copper, was first found, because there were only two known outcrops of copper in the entire district and they were both small and indistinct, not readily observable from a distance. In partial support of this viewpoint, Cleland (1952, p. 75) mentions that Dunn found a lead-iron outcrop. Also in favor of this argument, it should be remembered that until 1880 the most extensive work in the area was performed on the Hendricks, a lead-carbonate deposit (Duncan, November 12, 1911).

The proximity of this area to the Tombstone silver mines might suggest that Dunn's discovery was one of silver. However, such was likely not the case. If the outcrop had been silver, in all probability people would have been attracted to the district much more quickly, as they were at Tombstone. That it took Bisbee three years to become established as a mining district suggests that it was not silver they found. A secondary reason for this view is that, according to Trischka (Interview), there have

been no known silver outcrops in the entire Bisbee area; the silver found there occurs at considerable depth and is thoroughly diffused within the copper ore.

The indian-chasing duties of Dunn and his companions left them little time to develop their claim so they grubstaked a prospector, George Warren, who agreed to work it for half of the profits. It took Warren two months to reach the area, due to a side-trip to Fort Huachuca where he spent most of the time in a continual state of inebriation, and talking about the find Dunn had made (Cleland, 1952, p. 76). In time, Warren arrived at the claim site, accompanied by several friends, and proceeded to locate other, more valuable claims than the Rucker (Cox, 1938, p. 5). In all, twelve claim locations were filed during that first year; Warren's name appeared on eleven of them, Dunn's on one (Duncan, November 19, 1911). There is no mention of Dunn ever returning to his discovery; he was forgotten for many years, while Warren became known as the "Father of the Camp" (Copper Queen Bulletin, June, 1922, p. 7).

During 1878 and 1879 there was relatively little activity in the area. Other claims were located but none underwent extensive development. Duncan (November 12, 1911), who first entered the area in 1879, said that there were as few as eight people living there permanently and that few of the claims had been worked. The Hendricks

claim had the most work done on it. It constituted the district's largest deposit of lead-carbonate.

A crude smelter was built in 1878 near the spring at Castle Rock. This first smelter was little more than a water-jacketed stove to which was attached a set of blacksmith's handbellows (Duncan, November 19, 1911). A few small shipments of lead-carbonate ore were smelted and sent to New York, but they failed to pay expenses (Ibid.). From time to time lead-carbonate was also sent to Charleston where it was used as flux in the silver smelters. There seems to be no record of how much ore was used for this purpose, but it is thought to have been a small amount (Hogue and Wilson, 1950, p. 19).

In 1880 the Bisbee district underwent a rapid change; activity associated with the mines began to escalate dramatically. The activity was principally the result of more stable economic conditions throughout the Southwest, brought about by the appearance of the railroads (Douglas, 1913, p. 533). The Southern Pacific and later, the Santa Fe, soon provided southern Arizona with a mode of dependable, low-cost transportation, the type badly needed by the mineral industries. Copper, particularly, because of its relatively low price per unit volume, was dependent on low-cost transportation; few Arizona copper producers could successfully compete for eastern markets

against other, more advantageously situated producers (Ibid.).

The presence of the railroad was immediately manifest in land values. In 1879, shortly before the Southern Pacific was extended into southern Arizona, an Indiana mineralogist offered \$1700 for eight of the most promising claims, the millsite, and the spring by Castle Rock. His offer was refused, but would have been accepted had he raised it by \$400 (Duncan, November 12, 1911). Less than a year later, \$20,000 was paid for just two of these claims, the Copper Queen and the Copper King.

The early histories of the Copper Queen Mine and the Bisbee district are virtually the same. The Copper Queen was one of the early mines patented by Warren and his associates. The first workings on this claim were conducted on one of the two copper outcroppings in the district (Trischka, Interview). That the Copper Queen was destined to become the major early producer of the district certainly was not realized by either Warren or the other individuals who allowed it to slip through their hands. The Copper Queen group of mines eventually paid over \$180,000,000 in dividends (Cleland, 1952, p. 75). Throughout the period covered in this chapter, the Copper Queen was the only large-scale producer in the area.

In 1880 a Tucson merchant, L. Zeckendorf, and a Pennsylvania lawyer, Edward Reilly, enthused by what they

saw, obtained an option on the Copper Queen and Copper King, an option that was to remove the Copper Queen from the ranks of the insignificant into the realm of the important. At that time, the Glory Hole, as it was later called, was a cut four feet wide, running ten feet into the side of the hill. At the mouth of the cut was a half ton of fine green carbonate ore, which assayed twenty-two percent copper (Duncan, November 12, 1911). The option was presented to a firm of San Francisco railroad engineers who exercised it and bought the Copper Queen and Copper King for \$20,000 (McClintock, 1916, p. 426). They immediately began to make their investment worthwhile.

Within two months after the purchase, they built a smelter at the foot of Queen Hill, directly below the Glory Hole (Figure 5). It was a small smelter, consisting of a single thirty-six-inch water-jacket furnace (Copper Queen Mining Co., 1881, p. 7). Water for the furnace came from the nearest spring, at Castle Rock, via a small-diameter pipeline. The fuel consisted of oak and juniper trees, felled from the surrounding hills by Mexican labor. They cut the wood into the desired lengths and transported it to the smelter on burros. Above the smelter, on the same level as the mine entrance, was a mechanical ore crusher that broke the ore into small pieces so that it could be heated more quickly (Douglas, 1899, p. 538). From the crusher the broken ore was thrown into a chute which deposited it on



Figure 5. Bisbee during the early 1880's. In the upper left is the main street leading to the smelter.

Source: Arizona Pioneers Historical Society



Figure 6. Mules used to distribute the town's water supply during its early years.

Source: Arizona Pioneers Historical Society

the smelter floor (Copper Queen Mining Co., 1881, p. 7). The product of the smelter, black copper, now called blister copper, was 96.3% to 97% pure copper (Ibid.)--a very pure product for such a primitive smelter. Less than one year after the first furnace was blown-in, a second was installed. It was the same size and type as the first (Cox, 1938, p. 33).

Soon after large-scale production in the Copper Queen was started, an orebody was found that supplied the company with all its ore for the next three years. It was situated deeper in the mountain and at a slightly lower level than the original, smaller body. The new body was roughly circular, having a diameter of approximately sixty feet. It dipped thirty degrees toward the southeast for a distance of 400 feet and was enclosed in ledge-matter of kaolin which was in turn enclosed in limestone (Copper Queen Bulletin, June, 1922, p. 7). The officials of the Copper Queen described the ore as being pure: "There is neither gold, silver, arsenic, antimony, or any other impurity in the ore to affect the quality of the copper" (Copper Queen Mining Co., p. 7). The ore from the new ore body had a large percentage of copper. Table III shows the production figures for the first months at the Copper Queen. For over a year the ore averaged 23% copper.

Not only did the early ores possess large percentages of copper, but they were oxides (cuprite) and

TABLE III
 PRODUCTION OF THE COPPER QUEEN COMPANY*

Month	Tons of Ore Smelted	Tons of Copper Produced	% of Copper of the Ore
August, 1880	114-1/2	33-1/2	22%
September, 1880	579-1/2	159-1/2	26%
October, 1880	801	210-1/2	26%
November, 1880	616	144	23%
December, 1880	749	171-1/2	23%
January, 1881	719	146-1/2	20%

*Copper Queen Mining Company, 1881, p. 6

carbonates (malachite and azurite) and contained few sulfides (Douglas, 1899, p. 538). The absence of sulfides was significant, because non-sulfides could be smelted by a simple roasting, producing blister copper in a single, cost-saving process. (In later years the presence of sulfides in the ore complicated the smelting process necessitating a double roasting.) The single roasting in combination with the high-grade ores enabled Bisbee producers to compete successfully with most other areas, which in some cases were much closer to the Eastern markets.

As mentioned earlier, the railroads played a most important role in the development of the Bisbee area. The tracks of the Southern Pacific were the first laid across southern Arizona, and came closest to Bisbee at Benson (Figure 7). The distance between the towns was

Figure 7. Railroad expansion directly affecting Bisbee's development.

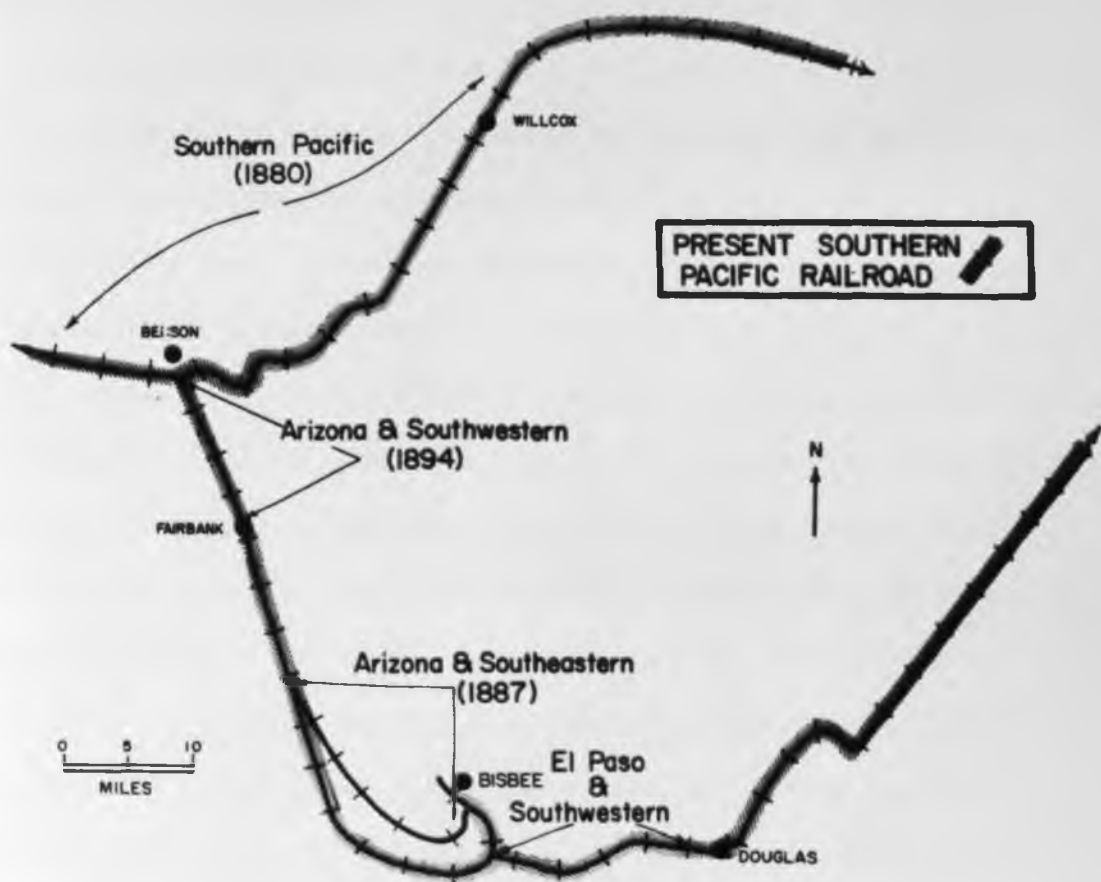


FIGURE 7

approximately sixty-five miles. Bisbee sent its copper to Benson in ore wagons, where it was loaded onto railroad cars and sent east. During 1880 the copper was shipped completely by rail from Benson to New York. However, in January, 1881, it began a new route which took it to San Francisco by rail, where it was loaded onto the ships of the Pacific Mail Steamship Company and sent by sea to New York, effecting a considerable saving on freight costs (Copper Queen Mining Company, 1881, p. 9).

The real problem, however, was moving material between Bisbee and Benson. Thousands of tons of timber, fuel, explosives, machinery, hardware, tools, chemicals, and other supplies for the mines and reduction works, plus all of the food, clothing, furniture, household articles, and all the other necessities with which the employees, their families, and the community about the mines must daily be supplied, had to be transferred from Benson to Bisbee. The enormous quantities of ore, concentrates, mattes, and kindred products from the mines had to be shipped in the opposite direction (Cleland, 1952, p. 138). The transportation media used to move these materials were sturdy, high-sided ore wagons. These wagons were constructed of thick planks, bound together by metal strapping. They were about eight feet long, five or six feet high, three feet wide, and held about four tons. Eighteen to

twenty mules were used to pull three or four of the wagons in tandem fashion.

During 1880 and the first half of 1881, freight leaving and entering Bisbee did so through Black Gap, south of town. From there the route skirted the Naco Hills to Hereford. North from Hereford it followed the San Pedro River to Benson. In 1881 the route was shortened; instead of going south to Black Gap, it proceeded northwest up Tombstone Canyon, over Mule Pass, and down into the San Pedro Valley to Charleston, on the river, and from there it followed the old route into Benson. Seven miles were saved by this newer route (Burgess, Interview).

In 1883 the Atlantic and Pacific Railroad (the present Santa Fe) constructed a line from Benson to Guaymas, Mexico, by way of Nogales, called the Sonoran Railroad. Under an agreement with the Southern Pacific, the Atlantic and Pacific connected with the former at Benson and used its tracks to connect with the main line of the Atlantic and Pacific at Deming, New Mexico. The route followed the San Pedro south out of Benson to Fairbank, where it left the river and proceeded southwest to Nogales. Bisbee was only twenty-eight miles from Fairbank, so the latter became the principal rail terminal for Bisbee. The Copper Queen was able to cut its shipping costs to eight dollars a ton, approximately half the cost of shipping to Benson (Cleland, 1952, p. 139).

The timber once so plentiful on the hills bounding Bisbee was quickly depleted. The first trees to disappear were the junipers which were chiefly used as underground support timbers. The miners turned to the Chiricahua Mountains, some forty miles to the northeast to refurbish the supply. The pines and junipers of that range were hauled by wagon across the Sulphur Spring Valley, and up Mule Gulch to the mines (Cox, 1938, p. 27). Most of the wood used as smelter fuel continued to come from the nearby hills because it did not have to be any certain length or shape; oak and manzanita served as adequate fuel wood (Ibid.).

As the intensity of the mining operations increased, so did the population. As mentioned earlier, Duncan stated that the camp had as few as eight people living there permanently in early 1879. Two years later the town's population had increased many times. One estimate places the population as high as 300 (Copper Queen Mining Company, 1881, p. 6); Cleland substantiates that figure (Cleland, 1952, p. 88). Because of its recent origin, Bisbee did not appear in the 1880 Census of Population, but photographs would indicate that the above figures are approximately correct. By 1881 Bisbee was beginning to look like a town. It had a post office, a brewery, a number of saloons, a restaurant, three boarding houses, a general store, a few tents, and many wooden shacks and houses (Cleland, 1952,

p. 88, and Cox, 1938, p. 27). At that time the town had two streets; the stage road that ran down the middle of the canyon from Mule Pass through the town and on toward the southeast following the old wagon route, and the narrow winding avenue that twisted through Brewery Gulch. Most of the commercial establishments were situated on the stage route, west of the entrance to Brewery Gulch. In the Gulch was the brewery and a few saloons. Brewery Gulch was also the locale of most of the town's prostitutes. (There seem to be no dates or figures to substantiate when these girls came to the area, or their number, but they were there and their number appears to have varied with the amount of copper produced.) The homes of the miners spread north and west of the smelter, which was the center of town (Ibid.). During these early years, probably few houses were built on relatively steep land; the sparceness of the population made it unnecessary to build on slopes.

No study of Bisbee's past would be complete without mentioning the man and the company that most influenced the development of that area; the man is James Douglas and the company Phelps Dodge. Douglas was a Canadian-born engineer, doctor, and minister, who by chance met with the officials of Phelps Dodge, then a small, but wealthy, import-export company in New England (Cleland, 1952, p. 90). Douglas was sent by that company to examine some mining claims in Arizona. On his second trip to the state, in 1881, he

recommended that Phelps Dodge purchase the Atlanta, a claim which bordered the southeastern side of the Copper Queen (Langton, 1949, p. 63). On his advice the Atlanta was purchased for \$40,000, even though it contained no known copper ore. Up to that time the only ore taken from the Atlanta was a small amount of cerrusite. Douglas later said that he recommended the purchase because the area appealed to him (Ibid.). No copper ore was found in the Atlanta for almost three years.

The latter part of 1883 was a gloomy period for the Bisbee district. Despite the expenditures of many thousands of dollars and almost three years of exploration, the Atlanta had not located a sufficiently large orebody to mine profitably. The Copper Queen was in almost as bad a situation. The great cylindrical orebody which had yielded such rich ore was nearing its end. The ore fanned out into many small stringers which led into the country rock, and which were not considered worth following (Ibid., p. 68). The management drifted a tunnel east along the Atlanta sideline and also west into the Copper King, but no orebody of any size was found (Douglas, 1924, p. 1). Both the Atlanta and Copper Queen owners were doing their last exploration work, preparatory to abandoning their properties. Looking back on the situation, it appears that at that time Bisbee was on the verge of becoming another Charleston or Jerome-- another abandoned mining camp.

CHAPTER IV

PERIOD OF GREATEST EXPANSION 1884-1916

This period is characterized by the most extensive growth in Bisbee's history. By 1884 Bisbee had progressed from a dusty little mining camp to a village of some 500 people. Its tents and lean-to's had given way to more permanent structures of wood and adobe. Data on the number and placement of the buildings is scarce, as are photographs of this period; however, there are enough of the latter to give a general idea of the type and distribution of the structures. (The photographs used for analysis were obtained from the University Library, Special Collections, and the Arizona Pioneers Historical Society.)

The stage road which descended Tombstone Canyon to the smelter developed as the mainstreet, and has remained such ever since. The small wooden buildings composing the business district lined each side of the road, immediately west of the smelter (Figures 8 and 9). Many of these buildings had square false-fronts, some had wooden sidewalks. Pictures show that there was at least one restaurant, a bakery, livery stable, Post Office, stage office, general store, two hotels, and more than one saloon. There were additional buildings, but their uses can not be



Figure 8. A view of Bisbee from the east in 1884.

Source: Arizona Pioneers Historical Society



Figure 9. A view of Bisbee from the west in 1884. Note the abundance of vegetation lining the street.

Source: Arizona Pioneers Historical Society

determined from the photographs. Lining the street on both sides were trees, most of which were oak, thick enough in places to shade almost the entire roadway. A secondary commercial district developed near the entrance to Brewery Gulch, where the principal building was the adobe brewery that gave the Gulch its name (Kelly, 1929, p. 86). Here, too, were a few saloons.

The dwellings generally were located north of Main Street and west of Brewery Gulch, as the most extensive area of level land was there. The houses were small, most appearing to have but one or two rooms; on the rear of some houses was added another room in lean-to fashion. Many of these buildings should not be called houses, but "shacks." The most common construction material was vertical siding of rough lumber. There were also a few adobe houses. At this stage of development there were no streets through the residential area; most of the houses were located in random fashion through that area, wherever there was unused ground close to the mine and smelter.

Mining, the basis for the area's development, was going through a critical period during the Spring of 1884. As mentioned in the previous chapter, the large, rich ore-body on which the Copper Queen Company had been working since 1880, had pinched out before the incline sunk in it had reached the 400-foot level. In search of another ore-body, a small tunnel, or drift, had been dug west into the

Copper King claim, and another east along the Atlanta side-line, but neither yielded an orebody of profitable dimensions (Douglas, 1899, p. 515). The Atlanta also had done its share of exploration, and had little to show for the three years' work. The situation was so bad that the owners of the Atlanta grudgingly put up \$15,000 for the last piece of exploration to be done on that claim, which was to be a vertical shaft, sunk to the 500-foot level (Douglas, 1909). Seeing that the end was near, the New York officers of the Copper Queen Company had relayed word to Bisbee that the smelter was to be prepared for dismantling, and the mining works abandoned (Douglas, 1899, p. 515). Almost as though it had been planned, with the morale of the camp at its lowest ebb, a large body of ore was uncovered simultaneously by the two companies, and Bisbee was saved (Cox, 1938, p. 42).

The new orebody, called the Atlanta, had a vertical extent of 200 feet with its ceiling 200 feet from the surface (Douglas, 1909). Its size was large, far larger than the former body in the Copper Queen, but its shape remained a mystery. So irregular was the shape that in many instances it could not be accurately determined until the actual excavation began (Douglas, 1899, p. 516). It was not as rich as the Queen body, but it contained more than enough copper to make its extraction profitable. The copper in the Atlanta orebody smelted out between eight and

ten percent, and the sulfur content was quite low, allowing the smelting to be continued as a single roasting process.

The results of preliminary exploration showed the new orebody to be almost evenly divided between the Copper Queen and Atlanta claims, which, under the "Law of the Apex" (See Appendix for definition), likely would result in costly litigation to prove which company had control of the ore. This did not happen because a merger was agreed upon, whereby the two companies joined to become the Copper Queen Consolidated Mining Company, principally under the control of Phelps Dodge who bought the interests of the owners of the Copper Queen company (Cleland, 1952, p. 102). With this merger, Bisbee once again became a one-company town.

Phelps Dodge, anxious to get a return on their investment, immediately began to increase production, but this was not done without problems. The price of copper had been slowly decreasing since 1881, and reached its low point in 1886 at eight cents a pound (Langton, 1940, p. 85); the two small furnaces in the antiquated smelter proved unable to handle increased production; and transportation problems were becoming financially unbearable, not only were the costs high, but the total tonnage was increasing faster than was the capacity for hauling it. James Douglas, who had moved into control of the entire Bisbee operation, began a systematic alleviation of these problems.

His solution to the problem of low price was to close both mines and smelter. He did this in the summer of 1886 (Cleland, 1952, p. 102). He was confident that prices would eventually rise, therefore this was an ideal time to effect some of the many changes so badly needed if production was to be increased.

The first major physical change was the demolition of the old smelter. The location was moved from the cramped quarters below the Glory Hole to a flat bench about one fourth of a mile to the east that had served as the slag dump for the old smelter (Douglas, 1899, p. 538). On this new site was constructed a large building that would not only house the furnaces installed at that time, and would allow for expansion of the number and size of the furnaces. Four new thirty-six inch water-jacket furnaces were installed. These were the same size as the old ones, but were modified for increased production (Cleland, 1952, p. 104).

In the mines also, this inoperative period was used to good advantage. It allowed for new exploration, as well as the implementation of needed repairs. The mines had been worked continuously for over five years and it was thought that if some of the shafts and tunnels were to continue in use, they would have to be strengthened by the addition of new timbers. In order to insure the future safety of the miners, a large proportion of the stopes (See

Appendix for definition) created by the removal of the original orebody were also re-timbered and many were filled-in with waste material.

In an attempt to solve some of the problems of transportation, a Fowler steam tractor was imported from England. It was a monstrous affair, somewhat resembling an early locomotive, but with its own steering mechanism and large, flat wheels equipped with steel treads. It was used to haul the wagons to Fairbank, as well as to haul ore from the Whitetail Deer mines on the south side of the district to the smelter (Cleland, 1952, p. 140). On the hard, well-packed roads of the upland areas, the engine worked well, and there were few hills it could not climb. However, when the roads were wet and muddy, or were sandy like those along the San Pedro River, it became hopelessly bogged. Of this engine, Douglas said that it gave its best service near the machine shop (Ibid.).

About the time that the smelter and mines were ready for operation, copper prices, at least as far as the Copper Queen was concerned, took a turn for the better. The French Secretan Syndicate agreed to buy one million pounds a month, at a rate of 12-1/4 to 14-1/4 cents a pound for a period of three years (Ibid., p. 105). Almost overnight, the large remodeling debt incurred by the Copper Queen disappeared.

With monthly production exceeding a million pounds, the problem of transportation became increasingly complex. The Fowler engine worked passably well, but did not exceed expectations. Another problem was the wagons; they were wooden, and did not hold up well on the rough, bumpy roads. With daily freight tonnages approaching one hundred, and growing, it was evident a better solution must be found.

The Santa Fe was approached concerning the possibility of running a branch line into Bisbee. The officials of that company viewed Bisbee's future growth and economic development somewhat pessimistically, so they declined the invitation. As a result, the Copper Queen Company decided to build its own railroad to Fairbank (Ibid., p. 141).

In 1887 a proposed route for a narrow-gauge track was surveyed up Tombstone Canyon and over Mule Pass, with an average grade of ten percent (Burgess, Interview). The steepness in grade would have limited the size of the trains, presenting drawbacks for future expansion. With this in mind, this route was abandoned in favor of one more level where standard-gauge track could be used (Douglas, 1909). The route that was finally chosen went south from Bisbee to Don Luis. From there it skirted the southern apron of the Naco Hills, and then to Fairbank (Figure 7). It did not follow the old freight trail along the San Pedro River from Hereford to Fairbank, but took the shorter, cross-country path which did not intersect with the river

until the settlement of Lewis Springs, ten miles south of Fairbank (Tombstone Quadrangle).

The construction of the railroad accomplished three objectives. First, freight costs were greatly reduced. The expense of shipping by wagon from Bisbee to Fairbank had originally been eight dollars per ton, this was eventually lowered to six dollars per ton (Douglas, 1909). The railroad, called the Arizona and Southeastern, further lowered the rate to 2.9 cents per ton mile, or one dollar per ton for the distance (Douglas, 1909). Second was the greater capacity of the railroad as compared with the mules and wagons, which would allow for future expansion. And third, thousands of tons of slag were removed from the dumps in Bisbee for use as roadbed material, so that the dumps could be filled again (Trischka, Interview).

Encouraged by the economic impetus provided by increased mining activity, Bisbee grew rapidly. By 1890 the population had expanded to 1,535 (Census of Population), a sizeable increase over the 1884 estimate. The row of stores and other commercial establishments along Main Street had been augmented by the addition of several new buildings, some of which were of brick construction. The largest building on Main Street was the brick library, constructed by Phelps Dodge for the residents of the town. The library constituted the eastern extremity of the business district; it was built near the site of the old

smelter. At the other end of the business district was a new hotel, apparently the largest in the town up to that time.

Brewery Gulch had expanded considerably since 1884. It was by 1890 the site of a thriving commercial district which stretched along both sides of the street (Figures 10 and 11). It was still secondary to the Main Street shopping district, and included many entertainment establishments, such as saloons, gambling houses, and houses of prostitution.

In addition to the business districts, the residential portion of the town had expanded in many directions. The main residential area, that north of Main Street and west of Brewery Gulch, extended its limits farther toward the north and the west. Here, houses on the periphery were built on the steeper slopes. The density of the dwellings in this area was higher than before. In fact, by this time there were few vacant lots in that entire area. Housing also extended west up Tombstone Canyon, past Castle Rock.

A new residential district had developed on Chihuahua Hill, east of the Gulch. This district stretched up the Gulch to the north and also toward the south, following the lower slopes of Chihuahua Hill. This area was characterized by closely packed dwellings, connected not by roads, but by paths and stairs. A particular type of dwelling appeared in this district that was not common



Figure 10. 1889 view of the entrance to Brewery Gulch. In the foreground is the railroad depot. Source: Arizona Pioneers Historical Society



Figure 11. Brewery Gulch business district, circa 1890. Source: Arizona Pioneers Historical Society

to the rest of the town. It was a row-house, sometimes as long as fifty or seventy-five feet, having five or six front doors. Probably these served as apartment buildings or houses of prostitution (Joralmen, 1936, p. 116). The foundation remnants of one of these buildings are seen in Figure 12. For the town as a whole, a common type of house was the two or three room cottage. Usually these were one or two rooms wide, with another room built on the rear. At this time there were a few oak trees still standing in the town. Most of these were near the Castle Rock area.

In the preceding chapter it was stated that during the early period all timber used in the area came from the surrounding hills. As the better quality timber became depleted, it was necessary to look elsewhere for the supply of long, straight timbers used as mine supports and building materials. A suitable supply was found at an elevation of 7,000 feet in the Chiricahua Mountains, on the east side of the Sulphur Spring Valley, about fifty-five miles from Bisbee. On a site in Rock Canyon was a sawmill where the trees were cut into the correct sizes and lengths. From there the wood was hauled by mule-team to Bisbee (Douglas, 1916, p. 21). This supply proved adequate for almost a decade, until the government intervened and decided that the land from which the wood was being removed was agricultural rather than mineral. A criminal suit was



Figure 12. The foundation remains of one of the early row houses in Brewery Gulch



Figure 13. The Copper Queen smelter with its two smokestacks on the side of Queen Hill. Note the complete absence of vegetation on the hillside. Ca. 1894.
Source: University of Arizona Library, Special Collections

filed against the Copper Queen (Douglas, 1916, p. 21).

Again the Queen was forced to find a new supply.

The next source of timber was Oregon, which turned out to be less expensive than wood from the Chiricahuas (Ibid.). This timber was shipped from Coos Bay by steamer to San Pedro, California, where it was loaded aboard the cars of the Southern Pacific (Douglas, 1909). This action greatly disturbed the officials of the Santa Fe because they thought that they could have supplied the lumber more cheaply had it been shipped direct to Guaymas, and brought north from there on their tracks (Douglas, 1909). As a counter measure, the Santa Fe traffic manager proceeded to charge maximum rates for moving the wood from Benson to Fairbank (Langton, 1940, p. 92). At once the Copper Queen retaliated by reviving the old teaming arrangement, and began construction of a track from Fairbank to Benson, paralleling the Santa Fe. The completion of this new stretch of track enabled the Copper Queen and Bisbee to assert their independence from the Santa Fe (Langton, 1940, p. 92).

The source of smelter fuel for many years remained centered in the hills around Bisbee. Unlike the timber used for construction and mine support purposes, the size and shape of fuel wood did not matter, as it was cut into short lengths and made into charcoal. What did matter, however, was the growing distance the Mexican wood-gatherers

were forced to travel in search of wood. As the hills closest the smelters were denuded, wood from farther and farther away had to be used, and the farther the wood-gatherers had to travel, the more expensive was the operation (Burgess, Interview).

As the actual expense of acquiring wood increased, so did another expense, that of clearing away the debris deposited by the resulting floods. Continual and increasing denudation of the hills gave rise to more frequent flooding as the capability of the hills to act as watersheds was methodically destroyed (Toles, 1964, p. 25). Douglas (1909) said that until 1882, when many of the surrounding hills had been robbed of their timber, there had never been a serious flood in Bisbee. After that date, flooding became more severe each year. With no vegetation to divert or absorb it, water rushed down the many small canyons after every rain, accumulated in Tombstone Canyon and Brewery Gulch and gushed toward the center of town. The effects of the floods were particularly bad, because both of the town's two business districts were located in canyon bottoms and were hard hit by each flood. The main business district in Tombstone Canyon suffered the most, because of the two sharp curves in the street which hindered the natural path of the water, causing heavy destruction to the nearby buildings.

A particularly bad flood in 1886 prompted the officials of the Copper Queen Company to seek a new fuel source (Langton, 1940, p. 86). Action on this matter had never before been instituted, because without railroad facilities into Bisbee it was not economical to import coal or coke. By 1886 the coming of the railroad was in sight, prompting this new move (Ibid.). Cardiff, New Mexico, and Trinidad, Colorado, were the nearest developed coal fields at that time. Coke was obtained from those areas as a partial substitute for wood (Ibid.). Later, when the railroad into Bisbee was finished, the complete conversion from wood to coke was made, and the hills were left to reforest themselves.

What the townspeople expected did not take place. New grass and trees did not take root on the barren hillsides; in fact, the hills became vegetatively more sterile. Not only did they remain bare, but the trees, grass, and flowers in the town also began to succumb, first slowly, and then at a more rapid rate. Pictures of Main Street taken during the middle 1880's show many trees lining both sides; the 1890 pictures show fewer trees, and those taken around 1900 show no trees at all. Toles (1964, p. 25) suggests that no one knew the reason why the vegetation died. This was not the case because James Douglas (1913) later stated that the smelters had caused this problem.

Until this time, only sulfur-free ores were worked; however, each new orebody contained a larger percentage of ore that contained sulfur, and as the non-sulfur ores were exhausted, it became necessary to use a greater percentage of sulfides (Langton, 1940, p. 97). The smelting of sulfide ores produced larger quantities of sulfur dioxide which was especially toxic to plants. The depressions of Mule Gulch and Tombstone Canyon apparently trapped this gas, which settled in low spots, thus magnifying its effects. In an effort to rid the area of the gas, two giant flues were built up the north side of Queen Hill in 1893 (Figure 13), using the hill for support. The stacks were an improvement but their effects were, after a time, largely nullified by the increasing amounts of sulfur-bearing ores smelted (Trischka, Interview).

Aside from destroying plant life, the presence of sulfides detracted from the quality of the blister copper. As early as 1886 a matte (See Appendix for definition) began to float on the copper ingots (Douglas, 1899, p. 538). At first it could be ladled out before it hardened, or could easily be chipped off after hardening, but as the amount of sulfur in the ore intensified, it became more difficult to separate the matte from the copper (Douglas, 1913, p. 539).

By 1892 the quality of the copper had diminished so as to affect its selling price. Douglas went to France

where he met with the French metallurgist, Manhes, who had succeeded in adapting the Bessemer process for use in smelting copper (Langton, 1940, p. 97). The adaptation of this process required considerable change in the Bisbee Works, even though many changes had been implemented since the smelters were first built (Douglas, 1909).

By the time the new process was adopted, the original thirty-six-inch water-jacket furnaces had been replaced by eighty by forty-two-inch furnaces (Douglas, 1909). These also had been replaced by even larger ones, 120 by 42-inches (Douglas, 1909). The new process required the use of barrel-type converters (See Appendix for definition), one furnace and one converter were coupled together (Douglas, 1899, p. 538). Molten ore was drained from the furnaces into the converters, where compressed air was blown through it, oxidizing the impurities which had previously formed matte (Douglas, 1899, p. 539). Before the advent of the converters, the blister copper had averaged 96% copper, the converters raised this to about 99% (Douglas, 1916, p. 20). The percentage of copper obtained from the ore was similarly raised from 7.5 to 8.2% (Douglas, 1913, p. 537).

The larger smelter processed more ore than did the smaller one. This made it possible for the district to accelerate its mineral production. As production increased, so did the population, as people moved in to fill the new

job openings. The 1890 population of 1,535 increased to an estimated 6,000 in 1900. (An estimate had to be used because the population of Bisbee was excluded from the 1900 Census.) Four years later this figure jumped to 10,060, according to Buck's Directory of Bisbee, Arizona, for 1904. Included in this volume are the names, addresses, and occupations of 4,025 adult males and widowed women; married women, children, and transients were excluded. The editor arrived at the final population figure by multiplying 4,025 by 2-1/2, which allowed for the women and children not included in the actual census (Buck, 1904, p. 3). This roughly corresponds to other estimates, such as made by Dr. Cohen (1962) at the same time, of 8,500. Whatever the precise figure, it is evident that between 1890 and 1904, the area grew tremendously.

Perhaps the most remarkable aspect of the Bisbee of 1900 to 1905 was not so much that it grew, but how it grew. Figure 14 shows the many more buildings the town had at this time; it also shows the types and kinds of buildings. Many of them, especially the larger ones, were constructed of brick, which connotes a sense of permanency. There was at that time a growing feeling that Bisbee was there to stay, and was a worthwhile investment. Possibly the incorporation of the town in 1902 furthered this belief (Bisbee Daily Review, August 3, 1931). By 1904 or 1905 had several good hotels, including the Copper Queen, which



Figure 14. Bisbee from the south in 1904.
Source: University of Arizona, Special
Collections



Figure 15. Bisbee, 1966. Note the fewer
buildings compared with Figure 14.

was owned by Phelps Dodge. There was a large Phelps Dodge Mercantile store and warehouse for the use of both Phelps Dodge employees and non-employees (Bisbee Daily Review, May 16, 1937). Also, there were schools, churches, and many commercial buildings. At this time the Brewery Gulch business district appears to have grown in size so as to equal the Main Street district. By this time gambling in the city had been outlawed, but prostitution still flourished (Bisbee City Code, 1902), principally in upper Brewery Gulch. If the old-timers who gather in the park may be believed, Bisbee once had over five hundred prostitutes.

The houses, too, began to take on a look of permanency. Smaller dwellings in the central part of town had been replaced by larger, more elaborate structures. Many had two stories, with second-floor balconies and ground-floor verandas. The simple undecorated wood of early days had been replaced, in many instances, by various styles of "gingerbread" trim. On the hillsides the houses were built farther and farther upward. Houses were scattered for almost a mile up Brewery Gulch, and for over a mile up Tombstone Canyon. The area southwest of the Main Street business district was also covered with houses, as was the entire south side of Chihuahua Hill, on the east side of town. If the town were to be divided along economic lines,

the Brewery Gulch and Chihuahua Hill areas would be the least prosperous portions of the town.

Another distinguishing characteristic marking this period from earlier ones, was the appearance of residential streets. Before, the only real streets were Main Street and Brewery Gulch. Houses were joined by dirt paths and wooden stairs, rather than by streets. By the turn of the century streets began to appear, especially in the central portion of town. It is interesting to note that even with the appearance of residential streets, most residences were associated with the various hills, rather than streets or roads. Buck's Directory (1904, p. 3) suggests that the streets be named and the houses numbered along them to correct the inconsistency of hillside numbering resulting from the haphazard practice of assigning houses numbers as they were built, somewhat disregarding their geographic placement.

The mining economy, meanwhile, was still developing rapidly. The turn of the century saw a further expansion of the company railroad. A mining property near Nacozari, Sonora was brought into the Phelps Dodge fold (Cleland, 1952, p. 135), and rather than smelt the ore in Mexico, it was decided that the smelting would be done in the United States. A route was surveyed southeast from Bisbee to the border, and then east across the Sulphur Spring Valley (Langton, 1940, p. 93). The point chosen to cross into

Mexico was the site of the present city of Douglas (Cleland, 1952, p. 143). That point was picked because it had already been decided that the Copper Queen would build a new smelter there.

There were many reasons for a new smelter location. The new site in Bisbee was cramped, with little room for expansion. Smoke and fumes became trapped in the canyon, making living conditions unsatisfactory for humans, and deadly for plants. An even more important reason was the acute shortage of water. Water was the one essential resource that Bisbee lacked. The small spring below Castle Rock served the two thirty-six-inch furnaces in a reasonably acceptable manner, but the more numerous large furnaces entirely overtaxed its ability and it dried up. Much of the water for the most recent smelter was supplied by the underground flow in the mines (Zipt, August 3, 1931). This was a large supply that increased with depth, but at times even it was not sufficient to fill the tremendous need. A well was drilled in the alluvial material near Naco and its product was piped seven miles to the smelter (Bisbee Daily Review, August 3, 1931), but this source had its drawbacks because it was so far from where it was needed.

In 1887 a square mile of land in the Sulphur Spring Valley had been drilled intensively to test if there was enough water present to support a planned fruit farm, and the supply was found to be plentiful (Langton, 1940, p. 97).

The Copper Queen took these findings under consideration and decided to relocate the smelter in that valley, directly north of the International Border (Cleland, 1952, p. 137). The Calumet and Arizona, a newly emerging company in Bisbee, also decided to build their first smelter in the same location (Cleland, 1952, p. 137, footnote #5). By 1902 the Calumet and Arizona Company had blown-in (See Appendix for definition) their first furnace, and by the following year were producing at full capacity (Langton, 1940, p. 97). The smelter of the Copper Queen Co. was somewhat larger and took longer to construct; consequently, it was not until 1904 that it was readied for production (Ibid.).

While the smelters were being constructed in Douglas, the final additions were made to the company railroad (its name was changed to the El Paso and Southwestern). The first addition, a 200 mile line from Douglas to El Paso, was built for two reasons: to end the costly backhauling of blister copper to Fairbank and Benson, and to give the mining area a direct connection with El Paso, independently of the Southern Pacific (Ibid., p. 96). The second addition was the purchase of the El Paso and Northeastern Railroad, a small line connecting El Paso with Dawson, New Mexico. The purpose of this purchase was to give the company access to the coal field it had bought near Dawson. This field, called the Stag Canyon Fuel

Company, was composed of 53,000 acres, 35,000 of them supposedly containing coal. Presumably this source of fuel was cheaper than either Deming or Trinidad. This was the last railroad expansion of Phelps Dodge that had a direct effect on the Bisbee area.

Throughout its early history one of the more severe problems plaguing the area was a water shortage. The earliest settlers obtained their water from the spring below Castle Rock. It was not many years, however, before the water table was lowered and the spring ran dry (Bisbee Daily Review, August 3, 1931). A few shallow wells were drilled, but most of these gave water only during the rainy months. Sometime during the early 1880's a water delivery service was started by the local businessmen. Water from a spring and runoff was drained into metal tanks. Burros formed the method of delivery; each one was fitted with two twenty-gallon canvas sacks (Figure 6). Mexicans led the burros from house to house over the hillsides (Ibid.). The cost for twenty gallons of this good mountain water was fifty cents (Henderson).

When the Copper Queen drilled the well in Naco and constructed their pipeline to the smelter, the town fathers made plans to follow suit. A development company was formed and money raised to drill a well and construct a nine-mile, ten-inch pipeline from Naco to a storage tank in Tombstone Canyon (Ibid.). From this distribution point,

the water was piped by gravity feed to many of the houses and commercial establishments. Those people who could not afford to have the water piped into their houses, obtained their supply at various distribution points throughout the town (Ibid.).

Coincident with the economic and social aspects of change in Bisbee was a considerable degree of physical alteration to the natural features of the area. Besides the underground transformation caused by the mining activities, there were many significant surface changes. Evidence of this is found on the eastern slope of Queen Hill. Here are a varied assortment of cracks and fissures, examples of these are shown in Figures 16 and 17. Some of the fissures are over one hundred feet in length and up to thirty feet in width. The probable cause of these fissures and depressions is the phenomenal amount of underground workings which were opened in Queen Hill during the 1880's and 90's. One source estimates that shortly after the turn of the century there were over 250 miles of tunnels beneath this general area (Cleland, 1952, p. 108). Figure 18 shows some of the tunnels, stopes, and shafts carved out of this one area by 1902. It is still evident that the entire core of Queen Hill was densely honey-combed with workings, many of which were never back-filled and remained open. The heavy dashed line gives the approximate location of the surface fissures appearing on that hill today.



Figure 16. One of the many cavities on Queen Hill caused by the cave-in of underground workings.



Figure 17. Small fault or fissure on Queen Hill caused by sub-surface slumping.

Figure 18. The major underground workings beneath Queen Hill in 1902. Present surface fissures are shown by the heavy dashed line.

Source: F. L. Ransome (1904)



FIGURE 18

The fissures and depressions found on Queen Hill are by no means of recent origin. In 1899 the mining industry was already cognizant of the condition of the hill, and of its probable causes. Douglas (1899, p. 521) wrote:

The whole hill is in a state of ceaseless movement. The comparatively shallow capping of limestone is fissured to the surface in all directions, and the lateral strains on the partitions of limestones which separate the masses of ledge-matter, when large stopes are made in them, cause these partitions to yield. The slag dump in the valley east of the hill rests on detritus, beneath which is ledge-matter, and is a source of continual annoyance to the mine, as its pressure is continually squeezing up the ledge-matter in the eastern stopes of the mine.

To compensate for the softness of the ledge-matter (See Appendix for definition), enormous amounts of timber had to be used to support the openings. It was estimated that thirty board feet of timber were put into the mines for every ton of ore that was removed (Ibid., p. 530). So violent was the movement, that when old stopes were drifted through, the old timbers would be found upset and dislocated or crushed into chips, even though the usual size of the timbers was ten by ten or twelve by twelve inches (Ibid.).

More recently, Trischka (1934) has made reference to this phenomenon. According to him (p. 173) there is subsidence throughout the entire mining district, but it is worse on Queen Hill. The reason for this, as Douglas also

stated, is due to the very soft kaolin ledge-matter which surrounded many of the orebodies (p. 180). The hard ore was removed, leaving behind a hole, into which the ledge-matter soon caved, which in turn weakened the rock above causing some of it to break under the strain, creating the surface features in point. The reason most of the slumping and fissuring is limited to just the Queen Hill area is that that area is bounded on all sides by faults, which ease the strain on the rocks of the surrounding area (Ibid., p. 173).

Various residents of the town, when asked about the cracks on the hillside, were of the opinion that the openings have enlarged in recent years, although none of those questioned had any proof that this was so. The Phelps Dodge officials of the Warren office were most reluctant to discuss the subject, suggesting that their operational pamphlets might be of help--they were not. Little information was found which discussed the present state of the Queen Hill fissures in a scientific manner.

The ownership of the mining properties in the area was not at all static through this period. In 1884 the Copper Queen Company owned the most claims. The next year Phelps Dodge and The Copper Queen Consolidated Company took control of the property of the old Copper Queen Company to become the largest property owner in the area. In the years that followed, Phelps Dodge continued to buy many

additional claims. Shortly before the end of the century the Calumet and Arizona and its subsidiaries the Calumet and Pittsburg, and Lake Superior and Pittsburg, were organized and began to offer opposition to the older company in the quest for additional land. Figure 30 shows the mining properties of the larger companies in 1902. At that time Phelps Dodge owned by far the largest single group of claims. It is also evident that much of the land was not owned by the major companies, but was held in small parcels by many private individuals. A few of the private claims were being developed, but most of them lay idle.

The only major change of ownership during the last of this period took place in 1911 when the Calumet and Arizona Company assumed control of the Calumet and Pittsburg Companies. This merger put Calumet and Arizona on a par with the Copper Queen, and, in later years, led to strenuous competition for additional property rights (Hovland, 1923).

Toward the end of this period, the percentage of growth in the area slackened, but the absolute growth still continued. In 1910 the Census gives a figure of 9,100 for Bisbee, and 4,350 for the areas of Lowell and Warren, making the total for the entire area 13,450. These figures suggest leveling off of Bisbee's growth rate, but a large increase in the nearby communities of Lowell and Warren, and the smaller areas, such as Tintown.

Established in 1900, Lowell had a humble beginning. Its first three structures were two saloons and a livery stable, built to serve the men working in the most eastern portion of the district. Soon after, many of these same miners built houses there to avoid commuting the two miles to Bisbee (Bisbee Ore, 1916). The area grew in popularity as the center of mining gradually shifted toward the east. Lowell gave rise to many small suburbs of its own: Upper Lowell, Johnson Addition, Jiggersville, Bakerville, and Cochise. Each of these started as a small collection of houses near a mine shaft, but some grew to include a small shopping district (Douglas Daily International, May 1916, p. 39). By 1915, Lowell had a shopping district of moderate size, a population of 5,000 and an area larger than that of Bisbee (Ibid., p. 40).

The community of Warren was developed to serve one principal purpose, that of providing a residential district for the officials, supervisors, and other higher-paid workers of the mines (Burgess, Interview). Unlike Bisbee, Warren was not hemmed-in by confining hills. It was developed on a reasonably level alluvial plain which sloped toward the south. The streets were laid out in a wedge-shape, partially to best take advantage of the natural drainage and partially to fit the shape of the site, which narrows toward the south.

Warren was built by a company formed by the larger mining concerns, and was planned from the beginning, quite unlike many towns built in the same period. A complete water and sewer system was installed before any houses were erected. Many of the houses were financed by the companies, but the residents were urged to purchase them. By 1916 over ninety percent of the homes in Warren were owned by the people living in them (Bisbee Ore, 1916). With the houses, the residents also purchased the surface rights of their lots; however, the sub-surface or mineral rights remained in the control of the mining companies, particularly the Calumet and Arizona Company (Trischka, Interview).

Little is written about Tintown, because it was one of those areas about which no community likes to boast--it was a slum (Burgess, Interview). Tintown derived its name from the small metal-covered shacks that housed the Mexican laborers and their families. According to Mrs. Carl Trischka, the inhabitants of Tintown were excluded from the rest of the district because of their nationality, for Bisbee was an "American" camp. Until the end of the first World War Mexicans were not allowed to work underground; they had to take the lower-paying surface laborer positions, because they were thought to be undependable (Trischka, Interview). It is interesting to note that English-speaking foreigners from Canada, and the Cornish miners from Britain

were welcome in the district and were highly regarded by the mining community (Trischka, Interview).

In many ways 1916 marked the end of an era for the Bisbee district. The rapid population growth that characterized the early periods declined markedly after that date, especially in the townsite, which began to experience an absolute loss in its number of residents. Another major change was the introduction of open-pit mining after 1916, bringing with it economies of scale which enabled the area's extensive low-grade copper deposits to be utilized. These and other changes are discussed in the following chapter.

CHAPTER V

EVOLUTION OF MODERN BISBEE 1917-1966

During the early years of this period Bisbee's urban development reached its zenith. A population of over ten thousand crowded into the townsite encouraging migration to the other communities in the area. Figure 19 presents a picture of the settlement pattern, as well as the operative mines and railroads, in the early 1920's. Mining activities, while not reaching their peak, were also expanding, principally through the implementation of new technology which brought about the introduction of open-pit mining. Because of the influence on the development of the entire region, the mining activities will first be mentioned, followed by a discussion of the effects the changes in mining procedures have had and how the area has responded to these.

Previous to 1917 all mining in the district was done underground and may be considered as intensive, in that large amounts of labor were concentrated on relatively small, high-grade ore deposits. Beginning with the present period, miners in Bisbee began to think in terms of extensive mining, using less labor and more machinery to work larger, low-grade deposits from the surface. With

Figure 19. The Bisbee area about 1920, showing the population centers, railroads, and major mines.
Source: Richard Riddell, private collection

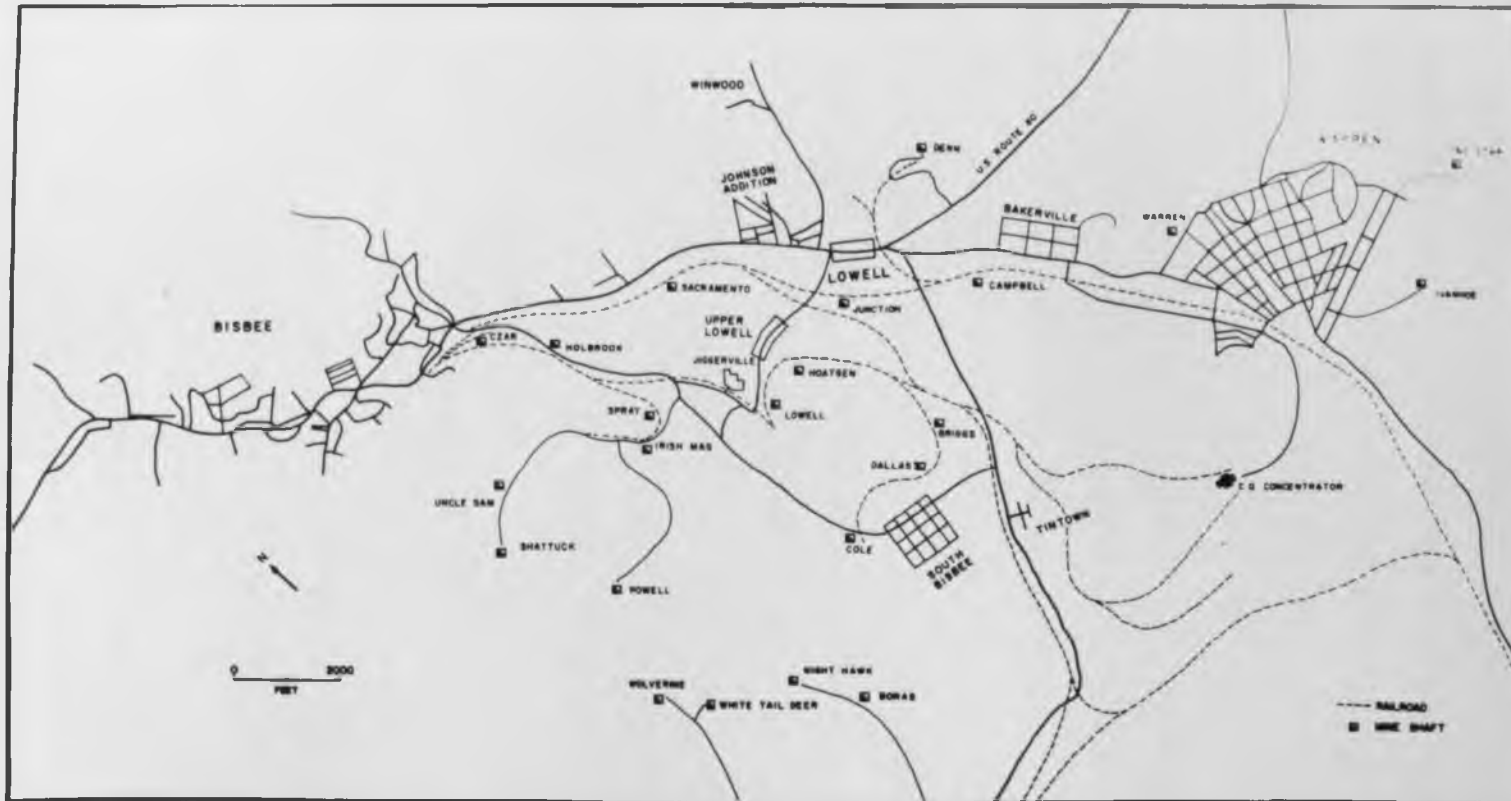


FIGURE 19

above-ground or open-pit mining came entirely new concepts of removing and reducing ore, as well as the substantial body of technology required to implement those concepts. Extensive operations had far-reaching effects on the area, not the least of which was the transformation of the natural landscape by the shifting of rock materials from one place to another. The two examples of open-pit mining in the Bisbee area are the Sacramento and Lavender Pits.

The orebodies composing the Sacramento and Lavender Pits were known as the Bisbee West and Bisbee East (Trischka, Interview). Each of these was directly connected with the intrusive mass of quartz monzonite porphyry that preceded the copper-bearing solutions; in fact, the Bisbee West orebody was the stock or core of the porphyry mass. A portion of the porphyry and the limestone capping it protruded a few hundred feet above the surrounding area, and was known as Sacramento Hill. Except for its darkly stained capping, much of Sacramento Hill contained low-grade copper ore, as did the ground under it.

The Bisbee East was separated from the Sacramento Hill mass by a ledge of limestone extending from near the surface to depth. This East orebody has a higher concentration of copper minerals now than it did in the geologic past, due to the process of secondary enrichment described in Chapter II, but still contains a smaller percentage of copper than the West orebody.

The presence of these two large ore masses was known long before they were developed. Ransome (1904, pp. 150-153) discussed the mineralization associated with Sacramento Hill, but because of its low copper content, did not consider it as ore. In his many writings, James Douglas made passing reference to these orebodies, but he too considered their copper content to be too low to be profitably extracted. It was not until the development of large-scale concentrating processes by D. C. Jackling (Fortune, 1932, p. 42), that the mineral possibilities of the orebodies were considered as being remotely capable of extraction. Jackling, working on the immense low-grade deposits of Bingham Canyon, Utah, took the principles of small-scale concentrators, already developed, and magnified them so that hundreds and even thousands of tons of ore could be treated daily (Dunning and Peplow, 1959, p. 131). According to Trischka (Interview), the knowledge of Jackling's methods of concentration transformed the Bisbee East and West orebodies from "dirt to ore."

The first exploratory work on these two orebodies actually was begun in 1911, when a tunnel was driven into the north side of Sacramento Hill to sample the ore (Hodgson, August 3, 1931). Later, in 1914, the hill was surveyed into squares, one hundred feet on a side; at every intersection a hole was drilled and an ore sample removed (Trischka, Interview). The samples indicated that the

orebody was of large size, and contained ore having from one to over four percent copper, with the average between 1.5 and 2.0 percent ("Moving Sacramento Hill," p. 848). On the basis of these estimates, a ninety-ton (per day) test concentrator was installed that same year, utilizing the methods initiated by Jackling (Hodgson, August 3, 1931).

The first six months of 1914 were active and considerable development was initiated, but in August there occurred the greatest curtailment of mining in the history of the district, up to that time. The Great War broke out in Europe, and because of their inexperience with large-scale war, both government and mining officials failed to foresee the tremendous amounts of copper that would be needed to win that conflict. As a consequence, the price of copper plummeted and mining camps all over the west ceased production (Trischka, Interview). Production remained curtailed for almost a year before it was realized that copper was more valuable during wartime than in peacetime. Operations resumed again on Sacramento Hill in 1917, by which time war shortages were apparent (Hodgson, August 3, 1931).

The mining processes used on Sacramento Hill did not vary appreciably from those used today in open-pit mining. The first operation involved the disposal of the limestone overburden, which had an average depth of 250

feet (Dunning and Peplow, 1959, p. 221). The rock was first drilled, then each hole was packed with dynamite and blasted. The broken rock was loaded by steamshovel into the hopper cars of the small ore trains. Each of these trains was composed of four to six cars pulled by a "donkey" locomotive (Cox, 1938, p. 161). The rock was hauled to the dumps and the ore to the small concentrater. The hill was dissected in a series of fifty-foot benches, each of which had its own drilling crew, steamshovel, and railroad track.

During the first years of overburden removal and preliminary work, the ninety-ton test concentrater was modified many times until the proper milling methods were developed. A site was selected on the side of a hill two miles south of the pit operations where a larger concentrater was constructed. The hillside site was chosen because it would allow solutions to move through the plant by gravity flow (Banks, 1919, p. 691). Nearby were areas of vacant land where tailings were dumped, as well as areas where leaching heaps were placed. (See Appendix for definition.) The concentrater had a capacity of 4,000 tons per day, and a concentration ratio of four to one (Ibid.), meaning that if ore entered the mill having a two percent copper content, the concentrate leaving the mill would have a copper content of about eight percent. Usually the copper

percentage of the concentrate averaged between six and eight percent ("Moving Sacramento Hill," 1920, p. 848).

Due to adverse economic conditions, it was not until 1923 that the overburden was completely removed and the concentrator ready for full-time operation. Once full-scale ore-removal was begun it became apparent that only one ton out of every three was ore (Cleland, 1952, p. 207), and that that one ton worked out to 1.48 percent copper (Elsing, 1923, p. 181). Preliminary sorting was done at the pit. Ore that was over 3.5 percent copper was sent directly to the smelter in Douglas, by-passing the concentrator; that averaging between one and three and one-half was sent to the concentrator; and the rest, ore with less than one percent copper, was deposited on the leaching heaps ("Moving Sacramento Hill," 1920, p. 848).

Steamshovel operations at Sacramento Pit ceased in 1929, when it became no longer profitable to lay the miles of switchback and spiral track needed to allow the ore trains to go into and get out of the pit (Young, 1930, p. 232). There was still ore beneath where the operations stopped, but it was most profitable to remove it from below, using a tunnel extended from the Sacramento shaft (Ibid.). The production figures, considering the short number of years ore was actually extracted, were remarkable. Approximately thirty-four million tons of rock were removed (Cleland, 1952, p. 207), of that, about ten million

tons were ore. In all, 218,000 tons of copper metal were produced, with about ten percent of that coming from the heap-leaching process (Dunning and Peplow, 1959, p. 221). The bottom of the pit was 650 feet below the original top of Sacramento Hill (Lea, Interview).

The change in the landscape created by the removal of the Bisbee West orebody was impressive. When above-ground operations were halted, most of Sacramento Hill had been removed except for a narrow slice on its north side and in its place was a pit three hundred feet deep (Figure 20). Portions of the landscape south of the pit were altered by the addition of waste material dumped into the ravines, as was the area north of Warren. Around the concentrator many acres of ground were covered with the remains of leach heaps and tailings piles. The operations at Sacramento Pit illustrated that open pit mining is an agent of tremendous local change, even though operations there were minor compared with those that followed.

The second period of open-pit mining in the Bisbee district, and the one which is still in operation, concerns the Lavender Pit mine. Development of this operation started in the early 1950's, twenty years after the close of the Sacramento Pit. The Lavender Pit operations are concentrated on the Bisbee East orebody. Like the Bisbee West, the presence of the East orebody was known for many years. As early as 1917, when the price of copper was



Figure 20. The dashed line delineates the depression where Sacramento Pit once was.



Figure 21. The Lavender Pit, 1964.
Source: Bisbee Chamber of Commerce.

high, preliminary excavation work was started on this orebody (Trischka, Interview); however, the copper percentage proved to be too low to be profitably exploited at that time, and work was halted. The next time the Bisbee East was considered was after the Second World War. Under the direction of Carl Trischka, exploratory drilling was begun, but again, due to low copper prices, work was halted. In 1950 full-scale development began (Tuck, 1963, p. 22).

The first step in the development was the drilling of over 300 sampling holes. From these, plus the assays from underground tunnels venturing into the orebody, the economic limits of the body were determined (Phelps Dodge, b). Material to be mined was estimated at forty-one million tons of ore averaging 1.14 percent copper, thirty-one million tons of leach material averaging 0.42 percent copper, and seventy million tons of barren waste material (Phelps Dodge, b).

Stripping operations were begun in 1951; before any ore was processed, approximately forty-six million tons of overburden were removed and trucked to the waste dumps (McPhee, 1954, p. 16). In some areas as much as 350 feet of overburden was dislodged before exposing ore. The developed area of the pit covered approximately 215 acres (Phelps Dodge, b). At the same time stripping was being done, a new concentrator was constructed. The old one, used in conjunction with the Sacramento Pit operations, was

too small. In addition, during the Second World War it had been adapted for lead and zinc concentrating, and would have required considerable alteration for use in copper (Trischka, Interview). These reasons, plus its two-mile distance from the pit, prompted Phelps Dodge not to use the old concentrator, but to construct a larger one. The new concentrator handles 12,000 tons per day, three times the capacity of the old mill. Perhaps the new concentrator's biggest asset is its proximity to the pit which allows it to receive ore via a conveyer belt. With the completion of the concentrator, the removal of the last of the overburden, and the construction of the various other facilities, the new pit was finally ready for operation, at a cost of almost four years and 25 million dollars (McPhee, 1954, p. 9).

The principal difference between the operations of the Lavender Pit and those of the Sacramento Pit, but for a few exceptions, is one of size. Ore is still broken with drills and dynamite, but the drills are larger than those used earlier. The steamshovels which collect the broken ore have more than four times the capacity of the older models. A major difference is that in the Lavender operations trucks are used to carry the ore to the primary crusher and conveyer and to dump the waste material on the dumps; trains performed both of those operations in the Sacramento Pit. Trucks are used because of their maneuverability and adaptability; they can climb steeper grades; do

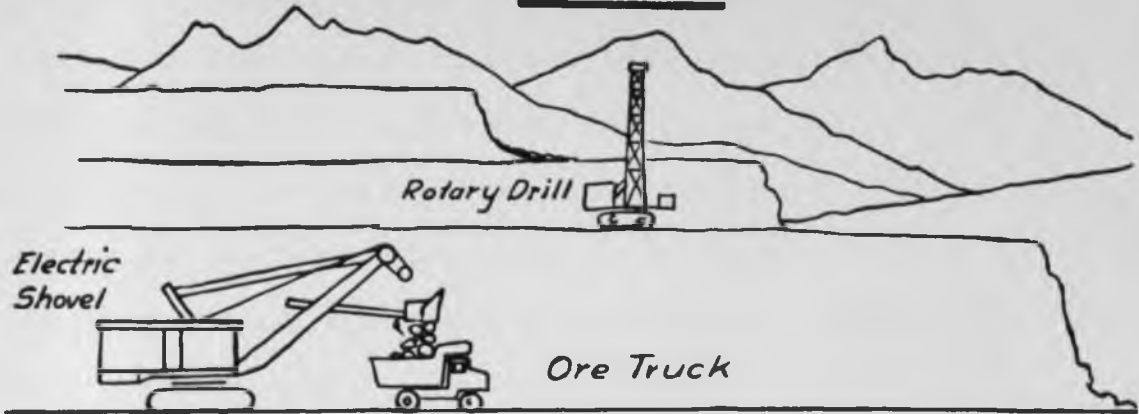
not need a track-laying crew to accompany them; can turn sharp corners, easing road-building requirements; and can haul larger loads than could the old railroad hopper-cars. The trucks used in Bisbee are of two sizes, thirty-five and sixty-five tons. The hopper cars used in the Sacramento operation had a capacity of forty-five tons (Lea, Interview). It is probable that if large trucks had been available for use in the Sacramento Pit, that operation would not have ended as quickly as it did.

The extracting processes used in the pit and the concentration procedures followed in the mill are illustrated schematically in Figure 22. Mobilized rotary drills bore blasting holes seven and twelve inches in diameter, spaced at fifteen to twenty-seven feet intervals, depending on the character of the rock. Each hole is filled with a powder charge of 450 to 1200 pounds, which also depends on the character of the rock. Approximately fifty tons of material are broken per foot of hole. Large boulders are set aside and are drilled and blasted individually (Phelps Dodge, a, pp. 5-6).

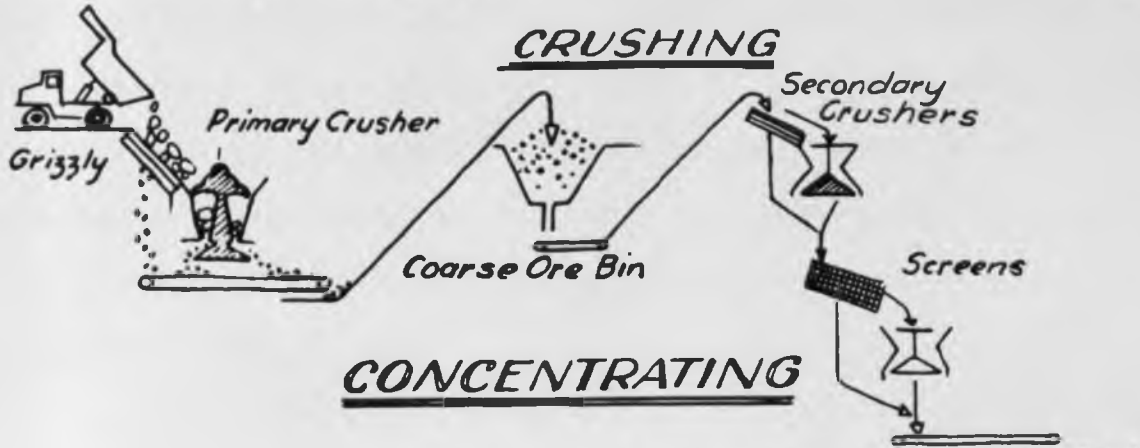
The broken material is loaded by electric shovels into trucks which transport the waste rock to the dump and the ore to the primary ore crusher located along the north wall, within the confines of the pit. A gyratory crusher reduces the ore to minus six inches and deposits it on a conveyer that moves it to the concentrator (Ibid.).

Figure 22. Schematic diagram of the extraction and concentration procedures of the Lavender Pit and Concentrater.
Source: Phelps Dodge Corporation

MINING



CRUSHING



CONCENTRATING

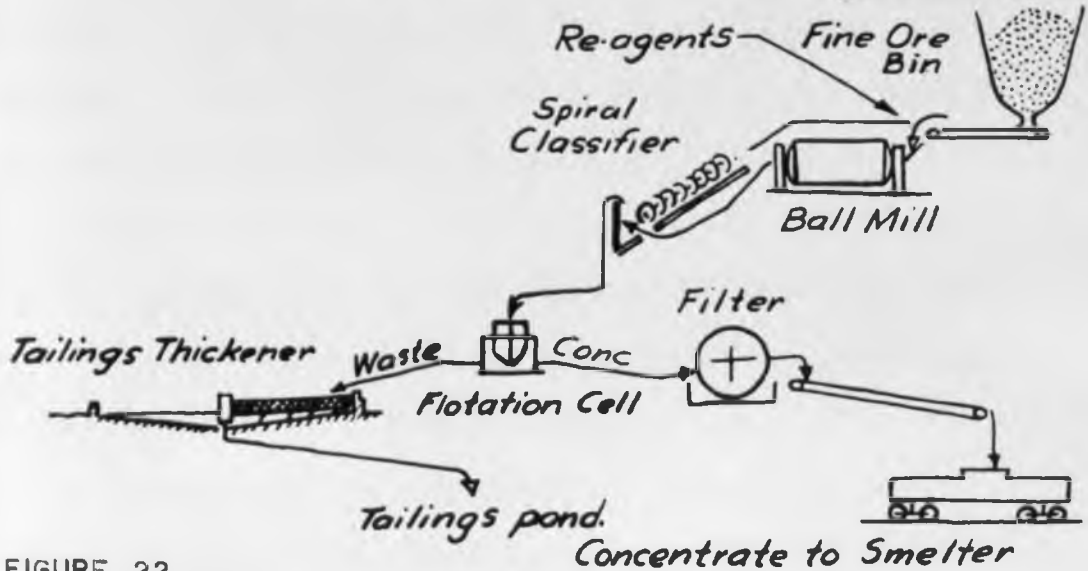


FIGURE 22

The concentrator is equipped with a series of crushers, screens, and ball mills which reduce the ore into a powder, fine enough to pass through a silk handkerchief. Chemical additives and re-agents transform the pulp of powdered ore and water into a soapy froth, by the agitating action of the flotation cells. To the froth are attracted the tiny copper-bearing particles which are then floated into another tank. The waste materials sink to the bottom and are discharged into large settling basins known as thickeners. From these, the waste is piped to the tailings pond south of the district. The concentrate, or end-product, is filtered to remove excess water, and is loaded into railroad cars and sent to the smelter at Douglas (McPhee, 1954, p. 16).

The grinding and flotation processes require tremendous amounts of water. After reclaiming water from tailings, concentrate, and thickeners, plus return water from the tailings pond, 200 gallons of make-up or additional water must be added for every ton of ore processed. The source of supply is the underground flow of the mines, which is pumped from the deserted Junction shaft and piped to the concentrator (Phelps Dodge, a, p. 11).

Throughout the history of the Bisbee area, mining activities have been responsible for many changes to the local landforms, but nothing in the past can compare with the destruction associated with the modern era of open-pit

mining. The Sacramento Pit was a big hole, but not so large that most of it could not later be filled in, which it was. The present, or Lavender, pit is nearing 800 feet in depth; its width is one-half mile; and its length is slightly more than that (Figure 21). It covers an area of approximately 215 acres (Phelps Dodge, b). In March, 1966 it was announced that the Lavender Pit is to be extended toward the west, and will eventually encompass all the area between Bisbee and Lowell, a distance of one and a half miles (Brewery Gulch Gazette, March 31, 1966).

In addition to this tremendous hole, many thousands of tons of waste material from the mine have been deposited on the outskirts of the area. The largest such deposit is Dump #7, located between Bakerville and Warren on the south, and Saginaw on the north. At present this dump is over a mile long, almost one-half mile wide at its eastern extremity, and 150 to 200 feet high. It has served as the principal waste deposition area since the opening of the Lavender Pit, and is composed of many millions of tons of rock material. Most of this dump is situated on formerly level land, which decreases its possibilities of being camouflaged. It appears that this huge mass of rock is to be a permanent part of the community which, for the residents of Warren in particular, is discouraging because it blocks their view of the mountains to the north.

South of the pit the natural landscape has also been altered, but on a smaller scale. The original topography of this area was composed of numerous small valleys and hills. The area has since been partially leveled by the filling with waste of many of the valleys. Further to the south is the tailings pond, the final resting place of the concentrator wastes. It represents an area of over one square mile of solid and liquid waste.

With the development of the two large pits was associated disruption of the settlement pattern. Such effects of the Sacramento Pit were few in number and of little importance because the original site was a hill, and as a result there were few houses or other structures near. Only the removal of a few houses, the company infirmary, and the power plant was required before development began. The growth of the Lavender Pit produced affects of greater magnitude. The removal of overburden was preceded by the relocation of some 250 houses comprising the communities of Lowell, Upper Lowell, Johnson Addition, and Jiggerville (Mrs. Carl Trischka, Interview). Most of the houses were relocated in a new community, Saginaw, north of Warren, with a few being moved to Galena and Briggs. In addition to houses, routes of transportation had to be changed. U. S. Highway 80 originally ran directly through the middle of the pit area; it had to be shifted toward the north, requiring part of that hill to

be cut away. The main line of the Southern Pacific into Bisbee cut across one corner of the pit, leading to its complete removal. It was not relocated, because several years earlier scheduled runs into Bisbee had been discontinued, and the track was used only for infrequent deliveries. One branch of the railroad was laid through Lowell to serve the concentrator there.

In the interim between the cessation of work in the Sacramento Pit and the development of the Lavender Pit, two major mergers were initiated. The first occurred in 1931, when the Calumet and Arizona Company became part of the Phelps Dodge organization (Phelps Dodge Corp., 1931, p. 4). The second was in 1948 when the Denn-Shattuck Company was also absorbed by Phelps Dodge. With these two acquisitions, Phelps Dodge again became the only mining company in Bisbee. Figures 30, 31, and 32 show the expansion by this company as it gradually gained control over most of the land in the district.

The flooding that plagued the townsite in early years occurred at less frequent intervals after the smelter was moved to Douglas in 1904. The absence of sulfur dioxide enabled the vegetation to once again grow on the hillsides reestablishing the water-balance destroyed in earlier years. Today the predominant type of tree on the hillsides around the townsite is the Emory oak (Quercus emoryi). It occurs in all sizes from small bushes to trees

thirty feet tall. Emory oak is especially thick on the hills north of town bounding Brewery Gulch. Other trees are Arizona cypress (Cupressus arizonica) and alligator juniper (Juniperus deppeana) which also are common on the hillsides. The hills in the southern portion of the district have fewer trees and shrubs. The most common plants there are yucca (Yucca, spp.) and ocotillo (Fouquieria splendens). Along the bottoms of the canyons are the water-loving Arizona walnuts (Juglans rupestris) and cottonwoods (Populus fremontii). The latter were cited by an unidentified Bisbee resident as being planted in Tombstone Canyon about fifty years ago. Many of the cottonwoods there today are forty or fifty feet tall. Box elder (Acer negundo) is also common along the lower portions of the canyons, as is the "tree of heaven" (Ailanthus altissima) which is a cultivated tree that has escaped from cultivation and is growing wild.

The above vegetation did not begin to grow immediately after the smelter was removed. It took many years for some types of vegetation to take root on the barren hills. One resident stated that it is only in the last few years that Emory oak have begun to cover the once bare Chihuahua Hill east of Brewery Gulch (Howe, Interview).

To protect Bisbee against flood-waters two artificial precautions were introduced. The first was a concrete

storm channel, built just after the turn of the century, which drains the entire length of Tombstone Canyon. This subway, ten or twelve feet wide and six to eight feet deep, has proven effective in channeling water away from the town's main business district (Cox, 1938, p. 122). Later, a series of small check-dams (Figure 23) were built during the depression of the 1930's by the Civilian Conservation Corps in many of the canyons and draws emptying into Tombstone Canyon and Brewery Gulch (Burgess, Interview). Although their size and holding capacities are small, these dams contribute a part in protecting Bisbee from floods.

During the early years of this modern period the population increased, but there are different figures for how great the increase was and when it reached its zenith. McKinney (1931, p. 24) says that the area had the most people, 15,600, in 1930. Mr. and Mrs. Carl Trischka (Interview) think that there may have been as many as 15-17,000 inhabitants in the area around 1926. The town newspaper, the Bisbee Daily Review, suggests the greatest population existed in 1916, when it was about 25,000 (August 3, 1931). Another source gives the 1927 population of the Bisbee townsite as 18,000, and that for the entire area as 25,000 (Clements, 1927, p. 35). The figures released by the Bureau of the Census are much lower, due in part to the absence of data for the other communities in



Figure 23. A small check-dam near the head of Brewery Gulch.



Figure 24. Houses being torn down to make way for the westward extension of the Lavender Pit.

the area. According to it, the largest number of people ever to reside in the townsite was 9,205, in 1920. This figure when added to the estimated totals for Lowell and Warren gives 16-17,000, which is probably close to the actual number of people living there in 1920.

It is evident from the Census data that the townsite grew little after 1910, when it had 9,000 residents, only 200 less than the 1920 figure. Pictures of the town taken during the early 1920's are practically the same as Figure 14, taken in 1904. By 1904 most of the major buildings were constructed, as were most of the houses, particularly the larger, fancier ones. The communities of the area that continued to expand were Lowell and Warren. People left Bisbee to escape its steep hills and cramped living conditions and to be closer to their work (Figure 25).

As stated in Chapter II, the copper deposits dip toward the southwest; therefore, mining activity started in the western portion of the district where the ore was closer to the surface and less expensive to mine, and gradually spread toward the southeast where the ore was found at increasingly greater depths, necessitating greater expenditures to extract it. The previous chapter mentioned that the communities of Lowell and Warren were started so that the miners could live close to the mines. This trend continued, causing the populations of Lowell and Warren to

Figure 25. Street pattern of the Bisbee townsite at its greatest extent, circa 1925.
Source: Richard Riddell, private collection

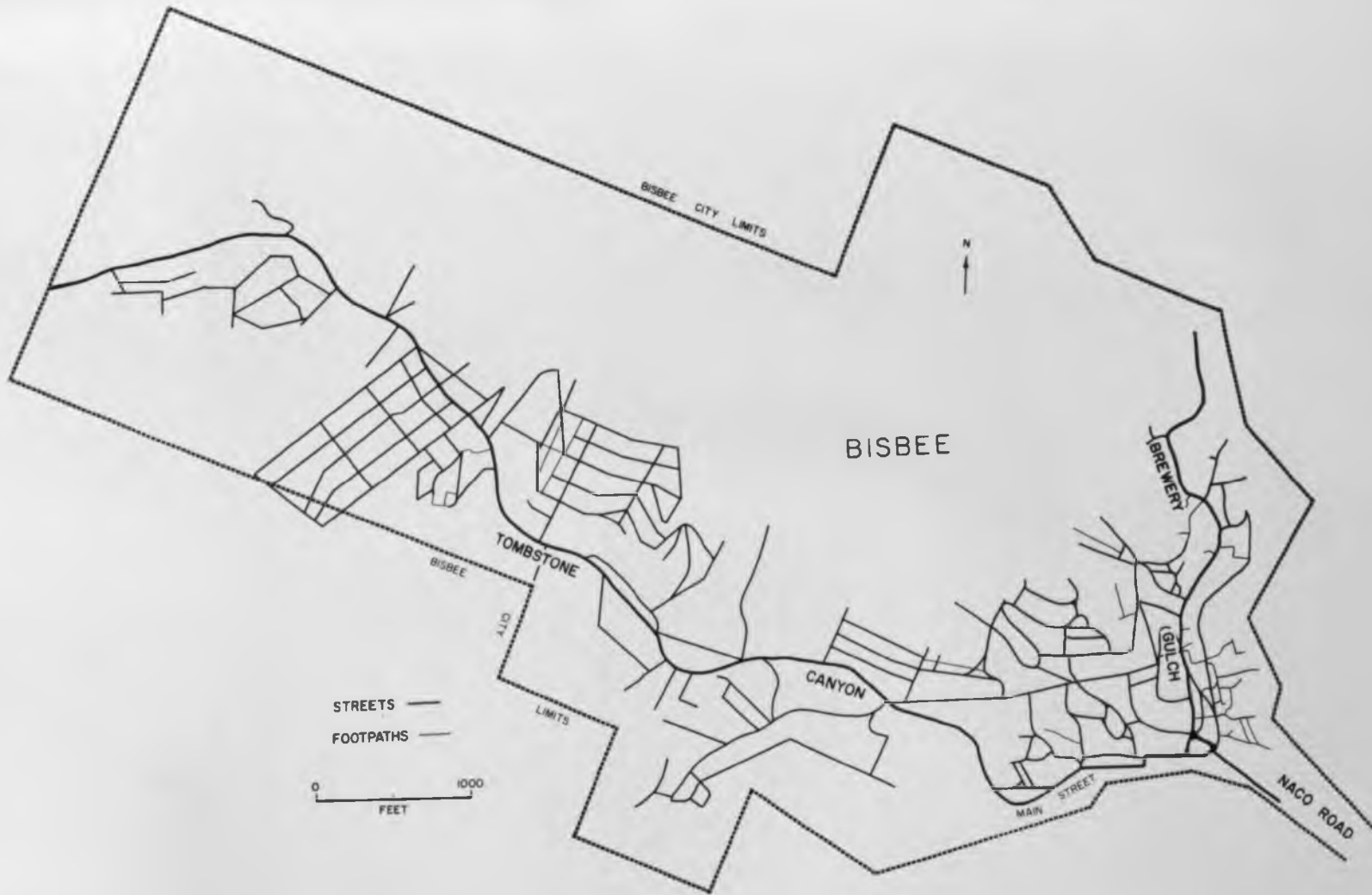


FIGURE 25

grow quite rapidly. By 1920 Lowell had a population of over 6,000, and Warren 1,500 (Bisbee Daily Review, August 3, 1931). The development of the Sacramento Pit encouraged this trend. The pit itself was closer to Lowell than to Bisbee, and the concentrator was about one mile from Lowell or Warren and almost three miles from Bisbee.

One reason that even more people did not leave Bisbee was the development of the streetcar system (Ibid., March 10, 1908). Begun as a luxury in 1908, it soon became a necessity to the miners working in the concentrator and the eastern shafts who wished to remain in Bisbee. Later the automobile took over this function and streetcar service was discontinued.

Beginning with the latter years of the 1920 decade, the entire area slowly began to lose population, partially because the Sacramento Pit operations started to slow down, finally stopping altogether in 1929. During the Depression of the early 1930's, the slow loss of people turned into a steady flow (Fortune, 1932, p. 47). Although the depression ended and full-scale mining resumed, the area continued to lose population. The Census gives the population of Bisbee alone as 8,000 in 1930, 5,850 in 1940, and 3,800 in 1950. It was not until that latter year that data was included for Lowell and Warren, which had 1,130, and 2,610 inhabitants, respectively. This gives a 1950 total of 7,540 people for the entire area, about one third its former

number. The last Census, 1960, credits the City of Bisbee, which includes all the communities in the area, with 9,900 people. This increase over the 1950 figure is principally the result of the Lavender Pit activities, which during early development created many new jobs in the area, and to the re-opening of Fort Huachuca in 1954 (Lea, Interview). Although neither of these activities employs great amounts of people, they have added to the stability of the area, helping to discourage people from leaving.

The modern picture of the older portions of the area is one of decline and stagnation. Bisbee has no new dwellings. On the hillsides are the remains of old foundations, stairs, and footpaths, mute evidence of former settlement (Figures 12, 24, and 27). Lowell, since the development of the Lavender Pit, has practically no houses at all. Warren has had some recent house construction, but of minor extent.

Evidence of the decline of the townsite is found in the present distribution of the establishments constituting the present central business district as compared with those which constituted the business district when Bisbee was at its zenith. There are, still standing, 128 buildings that were once part of the business district, shown by the dashed line in Figure 28. In 1966 only seventy of the 128 buildings house operative businesses, forming the central business district shown by the solid line in Figure 28. As



Figure 26. Houses on Chihuahua in 1916.
Source: University of Arizona Library,
Special Collections



Figure 27. A different view of the same hill
in 1966, with only the stone foundations
remaining.

Figure 28. Past and Present boundaries of the Bisbee central business district. Note that the 1966 business district is smaller than the 1920 district.
Source of base map: Bisbee Chamber of Commerce

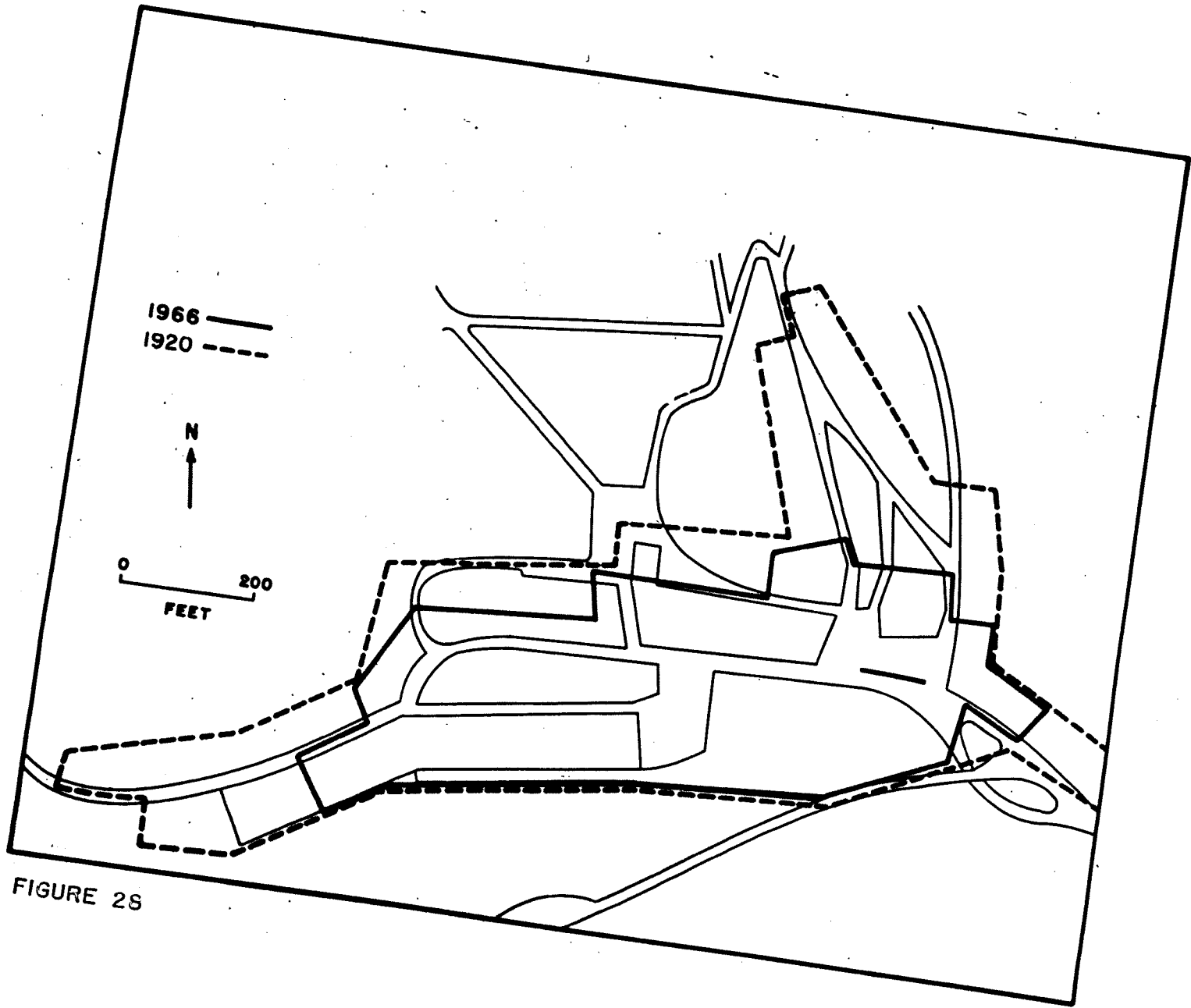


FIGURE 28

the population declined, the business district was withdrawn into a central core comparable with that of the 1890's. The outer extremities are being vacated in favor of the central core. As an example, there are at present in Brewery Gulch fifty-two commercial establishments; only eighteen of these are occupied today. The same is true of the western portion of the Main Street district which at one time extended to Castle Rock, but today ends about a block east of that point.

The area's second largest business district is located in Lowell. It appears to be losing businesses at a much slower rate than Bisbee. Lowell has forty-four potential business sites and thirty-six of those are occupied. Unlike Bisbee, there is no one area of vacant stores. However, Lowell certainly is not gaining any businesses, because there is not one new building in its shopping district. The reason for this is the proximity of Phelps Dodge. The company owns all the land surrounding Lowell, leaving no room for expansion. It is also likely that the company is not in favor of new expansion in that area because it is only a matter of time before the Lavender Pit encompasses the Lowell area, forcing the company to purchase the buildings there. It would be to the company's advantage to keep building values as low as possible.

Warren does not have one compact business district like Bisbee or Lowell, but two scattered areas. One of

these stretches along Bisbee Road between Warren and Lowell. The other is along Arizona Street, Warren's main street. Of the twenty-two buildings on Arizona Street, only two are vacant, and four have been built recently, indicating that perhaps this area is growing, not stagnating.

The subdivisions in the southern portion of the area have developed within the last decade, and are continuing to do so today. These newer communities are developing at the expense of the older ones. As their financial status improves, many people move into the new subdivisions, where the houses are modern and there is room for their children to play (Douglass, Interview). The people in the townsite who seem least interested in leaving are of Mexican descent. Many of these people live in the Brewery Gulch area, comprising the bulk of its population. The Gulch is characterized by many new automobiles and old, dilapidated dwellings, suggesting that its occupants are more interested in short-term goals such as the possession of the former, rather than in sacrificing both time and money to buy and take care of a new home (Howe, Interview).

The only shopping district in the southern section is a new community center, north of Huachuca Terrace. Of its sixteen stores, thirteen are occupied, including a Post Office, grocery store, and bank.

The hills bounding Bisbee combine to give the town-site a peculiar shape, but its shape is no more peculiar than that of the City of Bisbee. The latter, incorporated in 1959, includes most the district's population clusters (McCleneghan, 1960, p. 3). The reason for the distinctive boundary is that the areas between each center of population are not included within the city limits (Figure 29). For instance, Bisbee, Lowell, and Warren are all within the city, as are the roads joining them, the area between each is outside the city. The same is true of Don Luis and Huachuca Terrace, which are within the city, as is the road connecting them with Warren, but the major portion of the intervening area is outside the limits of the city.

The reason for the above is straight-forward; the Phelps Dodge Corporation owns practically all the land in the district, and at the time of incorporation was eager to have little of its land fall within the city limits where it would be subject to city taxes. The boundaries, therefore, were chosen to comply with company wishes (Douglass, Interview). As a result, the Lavender Pit, concentrator, tailings pond, waste dumps, and the major mines fall outside the Bisbee city limits. This may appear that the company is cheating the town of tax revenue, but it must be remembered that without Phelps Dodge there would be no Bisbee--at least according to Phelps Dodge.

**Figure 29. Boundaries of the present City of Bisbee.
Source: Bisbee Chamber of Commerce**

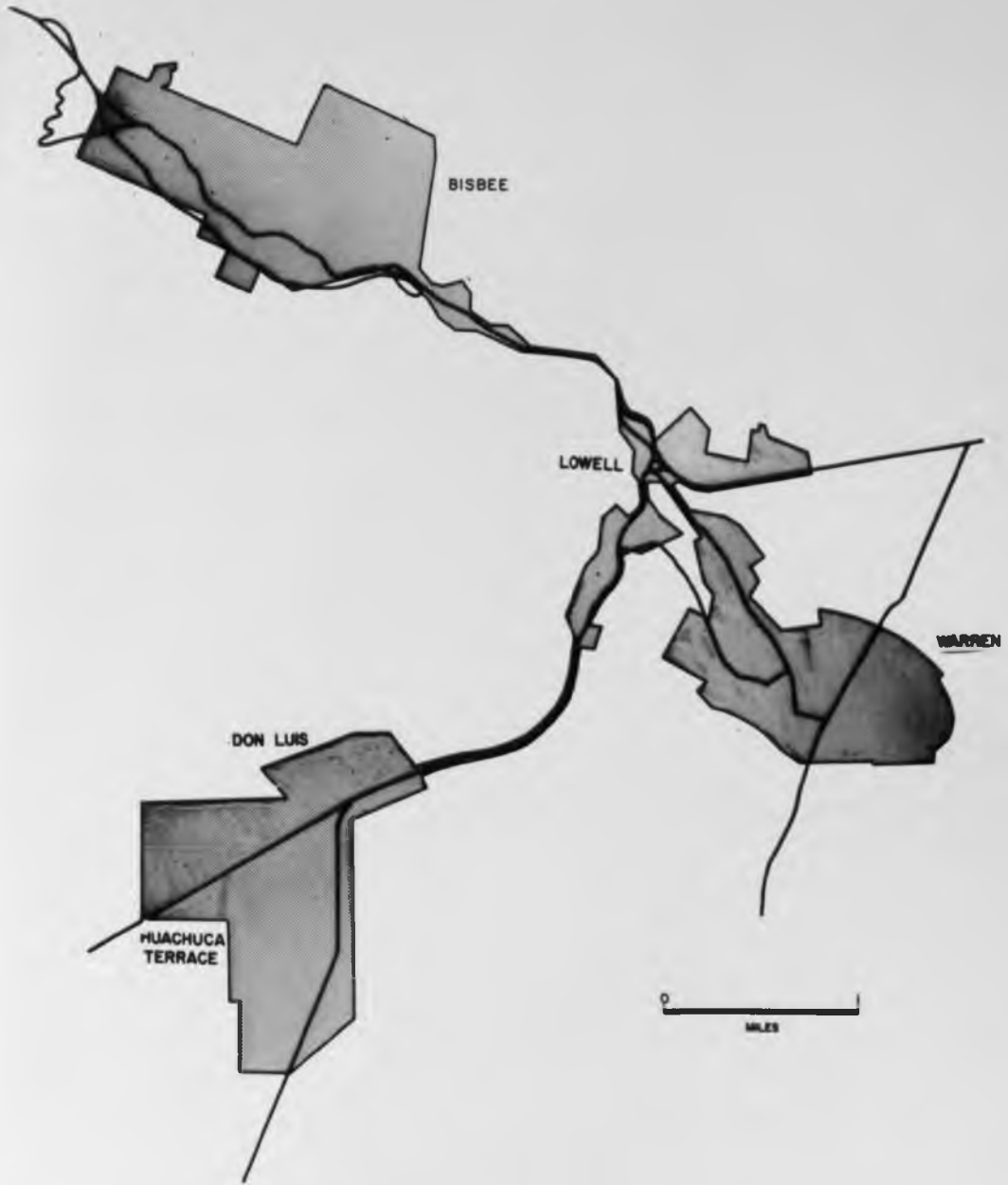


FIGURE 29

To compensate for the taxes it does not pay, Phelps Dodge provides a low-cost hospital, library, and other features such as a ball park and tennis courts. At times the company provides funds for special purposes, as it did for part of the cost of the new high school, and for various scholarships to students in the area. There is no question but what Phelps Dodge is benefiting from this arrangement more than is the City of Bisbee.

CHAPTER VI

SUMMARY AND CONCLUSION

The Bisbee area from its inception has been dependent solely upon mineral production. There probably has been no time in its history when Bisbee could have continued to survive if mining had ceased. Today mining is the only activity that brings a substantial amount of money into the area.

The historical geography of the Bisbee area is divided into three periods. The first of these concerns the discovery and initial development of the mineral resources. Though the first discoveries involved high-grade ore close to the surface, little development took place until low-cost transportation, in the form of the Southern Pacific Railroad, came to southern Arizona. The area then was quickly settled and mineral production began in earnest. Many of the original miners were of questionable merit, having been run out of Tombstone, Charleston, and other mining camps. The town they built consisted of a dishevelled collection of tents and shacks interspersed with saloons. The harshness of life kept away most women, leaving a predominantly male population.

Bisbee's most expansive era began in 1884 with the discovery of rich ore reserves of major proportions. With this, the long-range economic stability was enhanced, prompting new investment in the mines and also in the town. Of major importance was the extension of railroad facilities into Bisbee, which, more than any single occurrence, led to increased mineral production, enabling the economy to support a larger population. The resultant influx of people caused the town to expand and to rapidly assume the appearance of a small but prosperous city. The tents and shacks of earlier years gave way to permanent structures of wood and brick. Two business districts developed, with the principal one along the stage route. A smaller district grew up along Brewery Gulch. Residential districts evolved north and west of the business districts. As the Bisbee townsite became crowded, and as the mining activities shifted toward the east, there was a migration of some of the population from Bisbee to the communities of Lowell and Warren.

The final stage in the area's evolution spans the period from 1917 to the present. It began with the introduction of open-pit mining, of which there were two divisions, 1917-1929 and 1950-present. The growing scarcity of high-grade ores and the abundance of low-grade ores led to this type of large-scale mining operation. The mechanization of open-pit mining prompted a reduction in

the labor force, and a subsequent loss of population, causing the economic development of the area to stagnate. Especially in the townsite of Bisbee there developed a commercial tranquility that virtually precluded the erection of new buildings, either stores or houses. In the other communities of the area there has been a moderate amount of new construction, but usually at Bisbee's expense as people leave to escape its crowded streets and houses.

During the two earlier periods, there was a connection between the amount of copper production and the size of the population; as copper output rose, so did the population. Recently, because of open-pit mining and the subsequent introduction of technology permitting large amounts of copper to be removed by a relatively small work force, the population has declined in spite of a rise in copper production. At present it is most difficult to attempt to correlate the area's population with its mineral production.

A recurrent theme in this study has been that the steepness of the hills surrounding the Bisbee townsite effectively limited the horizontal spread of the town. Consequently, the town became densely settled and expanded up the hillsides, producing a pattern of curved and banked streets and houses crowded together. The steepness of the hills delayed the building of streets; it was only after the introduction of automobiles that residential streets

became common. There are still many houses that do not front on a street or alley.

Landscape changes resulting from the mining endeavors are another set of distinctive features of the Bisbee area. During the formative years of the district, surface disfiguration ensued principally from the beneficiation of ore; slag was piled into numerous dumps, and the hillsides were denuded as wood was cut for fuel. Later the sulfur dioxide fumes from the smelter succeeded in killing practically all the vegetation in the area. While underground, miles of tunnels and stopes rendered some areas almost hollow. One of the most extensively worked areas, Queen Hill, has many surface fissures and depressions resulting from the collapse of underground workings. In recent years the most dramatic landscape changes have been associated with the Lavender open-pit. Its depth is nearing 800 feet and it covers a third of a square mile. Associated with the pit are waste dumps and tailings piles which are in evidence throughout the area.

Throughout the history of the district there has been an evolution of ownership of the mining properties. For the first three years holdings were limited to single claims, individually-held. In 1880 the Copper Queen Company obtained control of six claims, making it the largest single landowner. When Phelps Dodge formed the Copper Queen Consolidated Company in 1885, it became the

district's largest landowner and has remained such ever since. Phelps Dodge continued to acquire land, until by 1902 it owned approximately fifty percent of the mining claims (Figure 30). By that time, however, there were other large companies operating in Bisbee, but none was as extensive as Phelps Dodge. By 1923 (Figure 31) the properties were firmly aligned into three major camps, Phelps Dodge, Calumet and Arizona, and Shattuck-Denn. A fourth, the Wolverine Company, played a minor role. Figure 31 illustrates that Phelps Dodge owned much of the land to the west where mining first began, but that Calumet and Arizona bought the land to the east and south, partially encircling the older company. In 1931 Calumet and Arizona merged with Phelps Dodge, leaving the latter in control of most of the properties and over eighty percent of the copper production. In 1948 the Shattuck-Denn Company also merged with the larger company and the district again was left to the mercy of one company (Figure 32).

According to some Bisbee residents the quality of the community declined when Phelps Dodge became the sole mining company. When the Calumet and Arizona and Shattuck-Denn Companies operated, the district had a band, an active YMCA, company baseball teams, and other similar social functions. Today there are none of these. One resident said that Phelps Dodge is trying to rid itself of the "father" image it once had in the community. In doing so,

Figure 30. Mining property ownership in 1902.
Source: F. L. Ransome (1904)

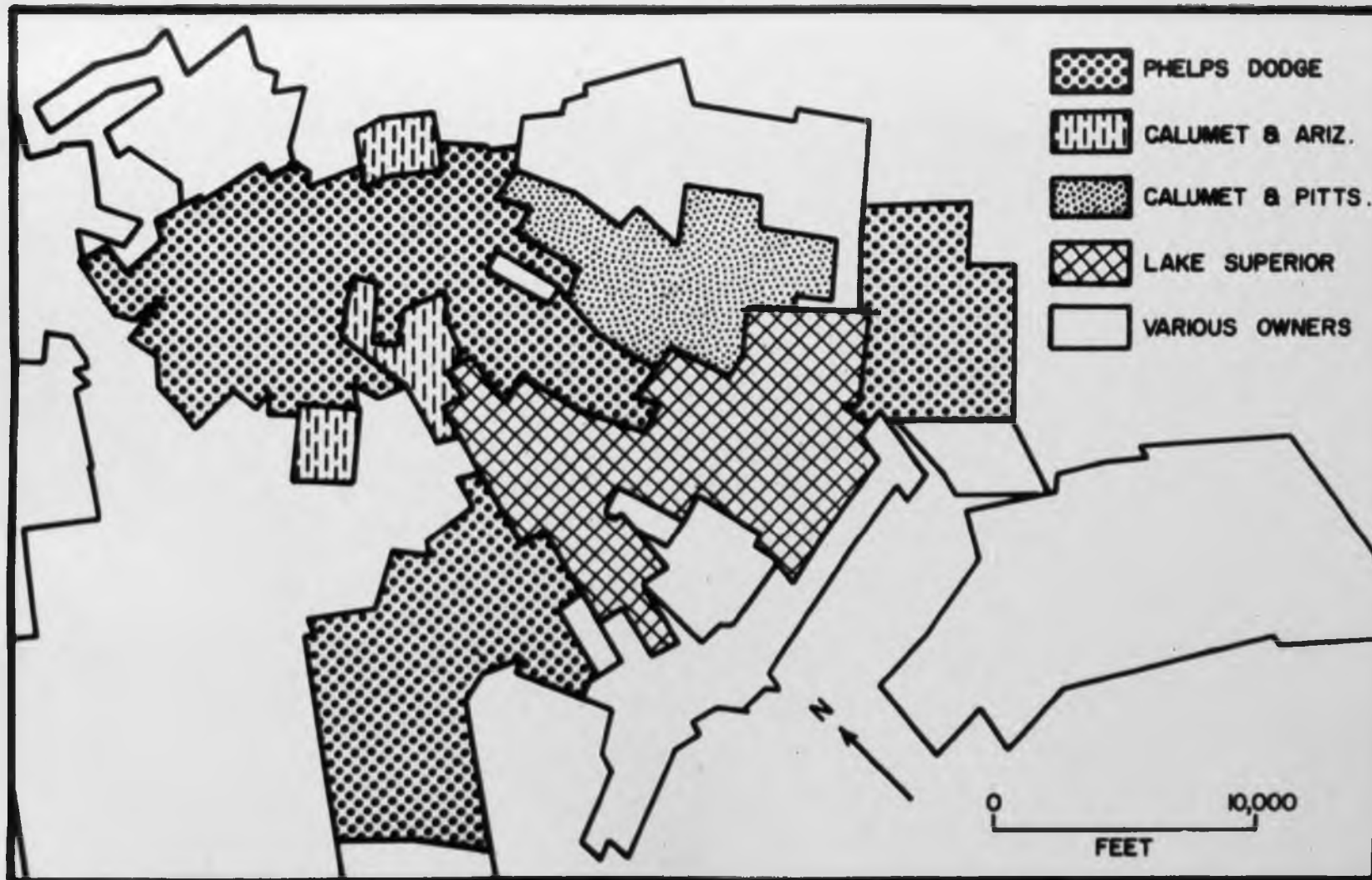


Figure 30

Figure 31. Mining property ownership in 1923.
Source: H. B. Hovland

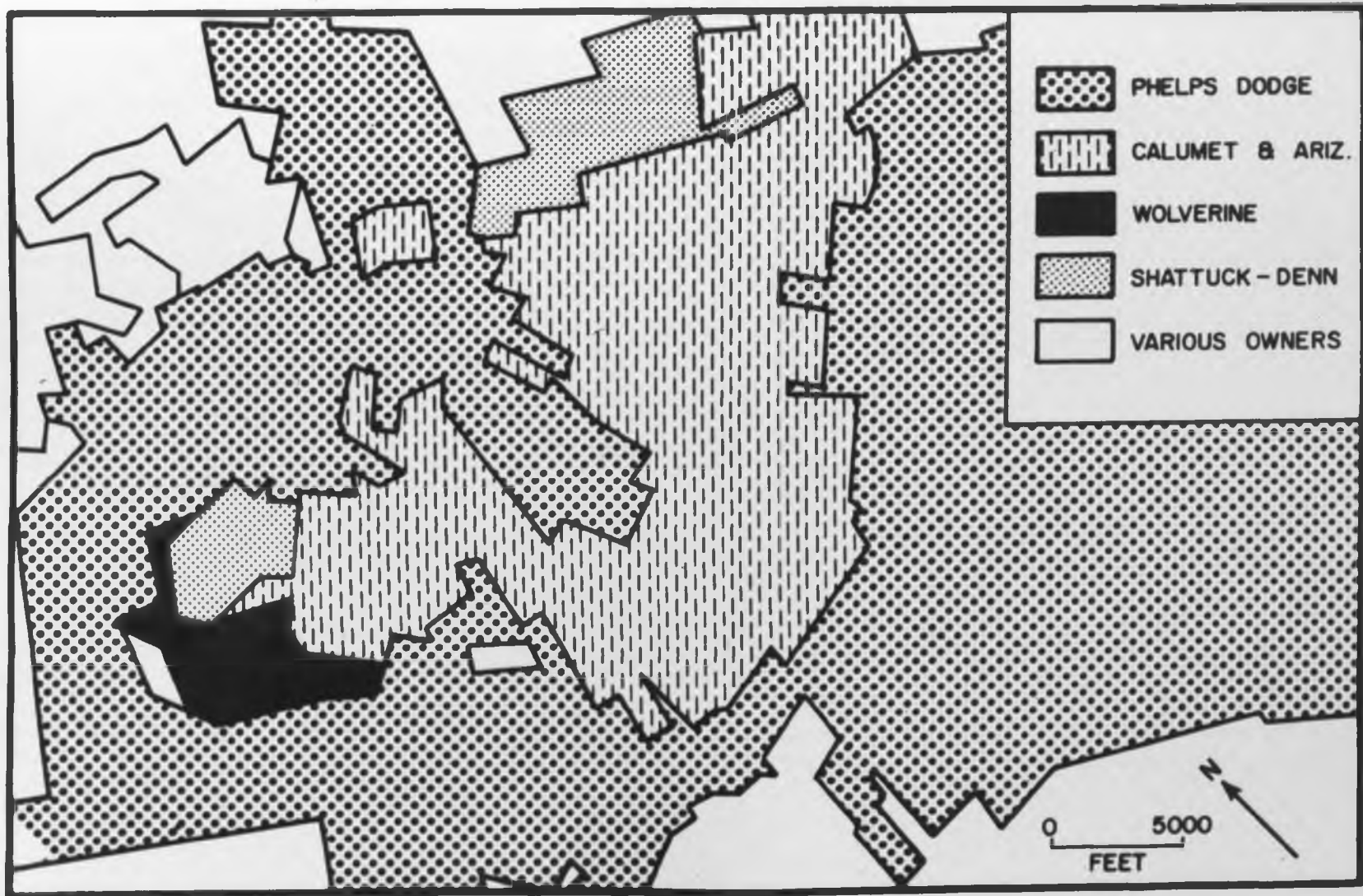


Figure 31

Figure 32. Mining property ownership in 1948.
Source: Richard Riddell, private collection

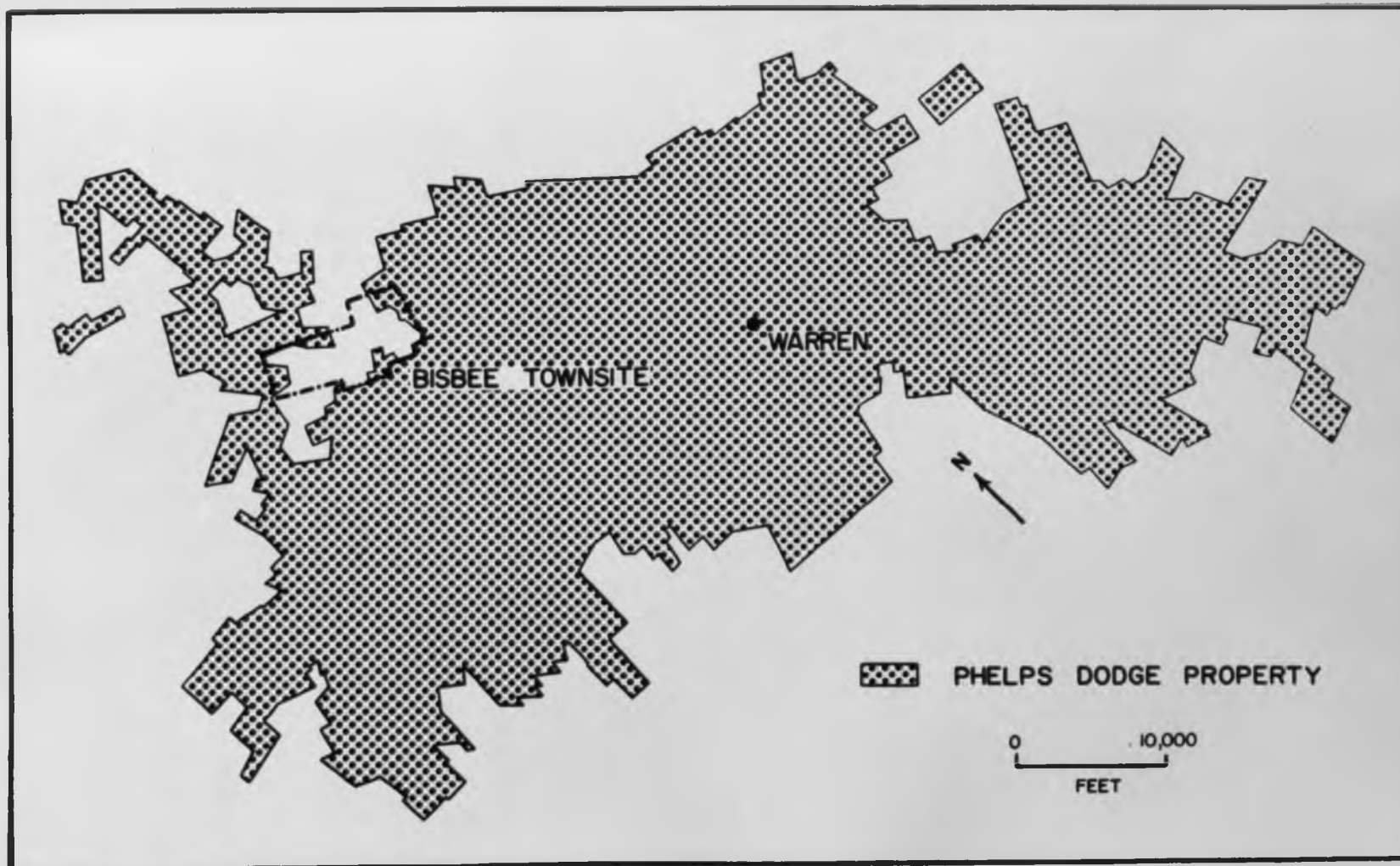


Figure 32

the company's interest has turned from community betterment to full-time profit-making. As a result, the company openly discourages new building, particularly in the Lowell-Bisbee area where there is the possibility of future pit expansion. The company also does not favor new industry, making Bisbee one of the few cities in the country not actively seeking to attract new industry.

Perhaps it is because Phelps Dodge is deriving more than an equal proportion of benefits from its relationship with Bisbee that the company conducts its business in such a secretive manner. The company discloses little information about its operations and instructs its employees to do likewise. As a consequence, many people are willing to discuss their grievances privately but few are willing to do so publicly for fear of company reprisal. Even businessmen not connected with the company are unwilling to speak out against Phelps Dodge for fear of an economic boycott. The company has control over the community and it aims not to relinquish that control. As an example, during the last strike, which lasted for about six months, the company store extended credit to all the striking workers, amounting to over one million dollars. In so doing, the bargaining power of the company was strengthened because most miners owed so much money to the store that they had to return to work to pay off the debt.

The power of the company in the community is further illustrated in the shape of the city boundary. It is almost unbelievable that none of the major Phelps Dodge properties are located within the city limits. This, perhaps more than anything else, illustrates that Bisbee lives by the grace of Phelps Dodge, and it is plausible to expect that when the company finishes with Bisbee, Bisbee will be finished.

It is not likely, however, that Phelps Dodge is going to leave Bisbee in the near future. In March of this year it was announced that the Lavender Pit is to be extended west toward the townsite. In the future the pit probably will be expanded to include Queen Hill, due to technological improvements, making it possible to extract lower grades of ore. When the Lavender Pit was started in 1950, fifteen and twenty-five ton trucks were used. Today most of the trucks are of sixty-five ton capacity. According to the chief pit engineer, the only thing preventing the use of the 100 and 110-ton trucks now available is the inability of the shovels to load them (Torgersen, Interview). Larger shovels are available and it is only a matter of time before they are put to use. When that happens, the present cost of thirty cents a ton for extracting the 0.7 percent ore will be reduced, enabling lower grades of ores to be processed (Ibid.). Some people hint that mining in Bisbee is about finished, but this is

unlikely. Before Bisbee and Phelps Dodge are divorced, the Lavender Pit possibly will cover the entire area.

Because Phelps Dodge probably will remain in Bisbee for many years does not mean that the townsite will remain as it is or start to grow. It is only through its staying-power or cultural inertia that the townsite is as large as it is. It is safe to presume that if the mines had been developed after the widespread introduction of the automobile Bisbee would never have evolved. Automobile transportation would have made it possible for the miners to work in Bisbee and live in the more spacious areas to the south. Therefore, it is safe to conclude that in Bisbee the significance of the relationship between man and nature changed as technology changed.

APPENDIX

GLOSSARY OF MINING TERMS

Blister copper: the finished product of the smelter, usually over 99% pure copper.

Converter: a large pear-shaped vessel used in the final step of copper smelting. Molten copper is placed in the converter, where compressed air is blown through it oxidizing the impurities.

Drift: an inclined tunnel driven through the country rock.

Heap-leaching: the process used to extract the mineral content of very low-grade copper ore. A solution of dilute sulfuric acid is allowed to percolate slowly through the broken ore, dissolving out the copper. The resulting solution is subjected to a chemical flotation treatment, forming copper concentrate.

Law of the apex: a law which allows the discoverer of a mineral outcrop to exploit it fully in depth and laterally.

Matte: the concentrated double sulfide of copper and iron produced at an intermediate stage in the smelting of copper.

Open-pit: a mine working open to the surface, similar to a quarry, usually characterized by a high degree of mechanization.

Ore: a solid, naturally occurring mineral aggregate of economic importance, from which one or more valuable constituents may be recovered by treatment.

Orebody: a mass of ore of any shape which may include low-grade and waste as well as valuable minerals, but is separate in form and character from the surrounding country rock.

- Outcrop:** that part of a rock stratum, vein, or seam that appears at the surface. It may be plainly visible or almost obscured by superficial deposits.
- Overburden:** the surface waste or worthless rock overlying an economic deposit; it is thin enough to warrant its removal to expose and mine the deposit by open-pit procedures.
- Porphyry:** a term applied to all rocks containing conspicuous phenocrysts in a fine-grained or aphanitic groundmass.
- Porphyry copper:** disseminated copper minerals in a large body of porphyry. In the commercial sense the term is applied to deposits characterized by huge size, particularly with respect to horizontal dimension, uniform dissemination and low average per ton copper content.
- Shaft:** a vertical or steeply inclined excavation or opening from the surface down through the strata to the mineral to be developed.
- Slag:** the fused product formed by the action of flux upon the gangue of an ore or fuel, or upon oxidized impurities in a metal.
- Stope:** any excavation in a mine, other than development workings, made for the purpose of extracting ore. The outlines of the orebody determine the outlines of the stope.
- Tunnel:** a horizontal or unclined drivage for development or to connect mine workings, seams, or shafts. It may be open at one end, and used for drainage, ventilation, haulage, or as an egress from mine workings.

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