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Mercury in the Terlingua District of Texas

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MERCURY IN THE TERLINGUA DISTRICT
OF TEXAS

by

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A

THESIS

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TABLE OF CONTENTS

ILLUSTRATIONS

INTRODUCTION

Material for this paper was assembled during 1936 when the author, with an associate, studied the Terlingua District and did some actual prospecting and mining in various parts of this district.

This paper endeavors to describe mercury mining in the Terlingua District of Texas generally. No attempt is made to treat any of the various aspects of this industry too technically as this is not the purpose of this paper.

THE DISTRICT

The Terlingua Quicksilver District is located in the lower end of Brewster County, Texas, in what is known as the Big Bend Country. This region is very rugged, almost bare of vegetation, and water is scarce. This is the last great wilderness of the vast State of Texas, full of the romantic appeal of old frontier Mexico. The majestic and picturesque Chisos Mountains are to the east, with Mt. Emory rising almost ten thousand feet above them. To the south is the Grand Canyon Santa Helena, through which the historical Rio Grande River flows. South of the Rio Grande rise the broad mountainous ranges of Coahuila, Mexico.

The small mining town of Terlingua is located approximately in the center of the present producing area. Terlingua is 90 miles south of Alpine, Texas, which is the nearest accessible town and railroad point. There is a fair truck road from Alpine to Terlingua, however, and the distance can easily be traveled in 5 hours. All supplies and quicksilver are hauled by truck at a medium cost.

Although the remoteness of this section and the generally inhospitable topography has held back prospecting and development, the possibilities of this district as a considerable quicksilver producer are now receiving long-due recognition by outside interests and several papers are now available which describe this region.°

°"The Occurrence of Quicksilver Ore Bodies" and "Quicksilver" by C.N.Schuette.

A paper on "Examination of Terlingua Quicksilver District" was being prepared by Clyde P. Ross in 1936 and should be available now.

GEOLOGY

The developed portion of the Terlingua Quicksilver District is an anticlinal structure about 15 miles long and 4 miles wide, with its long axis running approximately east and west. This anticline has been cross folded, faulted and intruded and lies at the intersection of two major lines of faulting.

The oldest formation extensively exposed within the District is the thick-bedded Edwards limestone, which is a hard, crystalline, light grey formation 1000 to 2000 feet thick. The upper 1000 feet of the Edwards limestone is called, locally, the Georgetown limestone and this upper layer has produced a considerable amount of quicksilver in the District. A definite fossil ledge occurs, in many places, at the base of the Georgetown layer. Exposures of the Edwards limestone are widespread in the western portion and absent in the eastern part except where exposed in fault scarps, as along the sharply defined "Long Draw" fault. This exposure in the west part results from the anticline being tilted, the west end being raised.

The Del Rio shale, a dark homogeneous, fine grained clay shale about 150 feet thick overlies the Edwards limestone. This highly impervious clay weathers easily and is exposed only in the broken folds and fault scarps. The University of Texas Bulletin° states that the Del Rio formation acted as an arrestor or retainer for the quick-silver bearing solutions. More than 80% of the quick-silver produced in the District has come from the base of this formation, or the contact of the clay and the Edwards limestone.

The Buda limestone overlies the Del Rio Clay. This pure, fine grained, almost white limestone is about 75 feet thick. Although mineral bearing veins which rise through this formation usually carry ore immediately above, they do not carry ore of a commercial value in the limestone itself.

Next come the Eagleford shales, which are composed largely of calcareous sandstone and shale with some lime-stone. These beds (called Boquillas flags by Udden) are approximately 600 feet thick here. Quicksilver has been produced from this formation, the major portion coming from the contact of the Eagleford shale with the Buda limestone, where the shale acted as an impervious capping to stop the mineralized solutions which penetrated this far.

The Chisos and Rainbow mines formerly produced from the Eagleford, but these erratic deposits have been aban-doned for the more certain ones at the base of the Del Rio

°The University of Texas Bulletin No. 1822 "The Anticlinal Theory as Applied to Some Quicksilver Deposits" clay. In Section 248° the Eagleford is exposed and the Waldron Company is at present producing some ore here. In years past some exceptionally rich ore bodies have been mined from this formation.

Next comes a formation composed of clay and shale called the Taylor Marl. This marl is about 200 feet thick in the vicinity of Chisos.

Above this are the Aguga and the Tornillo formations which will not be discussed as they are present in very few places in the District and do not carry appreciable quantities of the mineral under discussion.

These sedimentary beds are cut by numerous igneous intrusions in the east portion of the District, with only a few small such masses farther west. The beds exposed are middle to late Cretaceous in age, and the intrusives are probably post Cretaceous. See Exhibit I for the geological section of these strata.

° See map of District called Exhibit III.

OCCURRENCE OF MERCURY DEPOSITS

The known mercury deposits in the Terlingua District are all very similar, however they vary somewhat in detail. The most common ore is cinnabar, a sulphide of mercury (Hg S). There are occasional small pockets of the rarer minerals, and in the early history of this District native quicksilver, terlinguaite, kleinite and other rare mercury minerals were found, especially in the western part near California Mountain. Calcite is the common associate of cinnabar here, the gangue usually being a breccia of altered limestone and clay with ribs of coarsely crystalline calcite. Bituminous matter is present in some of the ore , as an impregnation of the calcite and limestone and which gives a dirty yellow color to them. The fresh fracture of impregnated material sometimes shows shiny black. The outcropping of calcite veins quite often indicates the presence of mercury. These veins are usually quite small although some are much wider as shown by the photograph Exhibit II. Sometimes the shales and igneous rocks are found impregnated with the mineral-the impregnated shale is called 'jaboncillo'.

Cinnabar deposits have been found in the Georgetown, the Del Rio, the Buda, the Eagleford and certain igneous formations. The cinnabar occurs as a crust on calcite, limestone replacement, stringers in igneous rock, and as an impregnation in shales. However, the main known ore horizon is the Georgetown-Del Rio contact, and wherever the structure is favorable along this contact cinnabar usually can be expected.

MINING OF CINNABAR DEPOSITS

The mining methods of the Terlingua District are typically Mexican. The major portion of the ore comes from shaft mines, although some ore is produced in the western portion from California Mountain, which is entered by several drifts. Some of the early workings were in surface ore and there are numerous open pits in the western portion.

The shafts are sunk through the cap rocks into the ore zone. The method of exploration is to follow the ore, and development is rarely ahead of the actual mining. The nature of cinnabar occurrence here makes it impractical to attempt to do much exploratory work in advance of actual mining. Where practical, some core drilling is done.

This ground stands well and no timber is used except in the shafts.

The mining method is usually underhand stoping, with some sorting done underground and more on the surface. The distinctive color of cinnabar makes handsorting very easy.

The costs of mining in the Terlingua District are exceptionally low. All labor is performed by Mexicans, who make quite good quicksilver miners. This is an important feature here. In the Terlingua District high-grade ore exists with low labor costs, which differs from the California situation which is low-grade ore with high labor costs. The type furnaces used give best results with one percent ore, and here where high and low grade ores exist together the low-grade ore is mixed with the high-grade ore to bring it to the proper percentage for efficient treatment; but where low-grade ore only exists, below half of one percent, it is often impossible to treat the same at a profit. This was the situation with the majority of the California quicksilver ores until the recent marked increase in price.° It is to be noted that the main producers in the Terlingua District have never had to cease operation entirely because of a low price of quicksilver. The following table shows the approximate wages for Texas and California mercury mining districts:

Comparative labor costs (per day)°°

	Texas	California
Shovelers	$1.25	$4.00-5.00
Miners	1.50 -2.00	4.50-5.00
Furnace men	1.50 -1.75	4.50
Roustabouts	1.25	4.00

° Refers to the several price increases during 1936.
°°Schuette, C.N., Quicksilver: Bulletin 335, page 26.

TREATMENT OF MERCURY ORE

The treatment of quicksilver ores to obtain the metal mercury is quite simple. The ore is heated in some type of furnace to about 700°C. In the direct-fired furnaces oxygen combines with the sulphur of the mercuric-sulphide (cinnabar) to form sulphur dioxide, and the quicksilver is set free in the form of a vapor which is condensed to the familiar liquid metal upon being cooled in a system of iron or tile pipes.

The average grade of ore sent to the furnaces in the District in 1934 was estimated by the operators to have been 1.2%. The distinctive vermilion color and weight of cinnabar makes selective hand sorting quite easy. Some sorting is done underground. As the ore comes to the furnace, the ore is sorted by hand as to the various percentages which the ores carry. An experienced sorter can judge, by the appearance and weight of the ore, to within a fraction of one percent just how much quicksilver it will carry. The sorter's job also is to assort the ore so that the furnace charge will be of the proper percentage to get the best recovery possible. Occasionally a rich pocket of ore may be found, running as high as 60 to 70 percent, which may contain several hundred or even thousand flasks of quicksilver. This ore is graded down by the addition of enough low grade ore so as to bring it to the proper percentage for the furnace treatment. The most efficient furnace operation is with 1% to 2% ore.

Formerly retorts were used for smelting and due to their small capacity, the grade of ore was maintained at 10% to 20 %, with 60% charges not uncommon. This practice proved wasteful, as low grade deposits had to be passed up, and was soon abandoned in favor of the larger tonnage, low grade plants. The present four producing plants smelt from 12 to 30 tons per day, or the total production from the Terlingua District is about 70 tons per day.

Practically all of the ore mined in the Terlingua District has been successfully treated in smelting furnaces of standard design and it would not be advisable to deviate from this practice. There are two Scott furnaces in operation in the District, one of 12 tons and the other of 20 tons daily capacity. The Scott furnace is a vertical shaft of fire brick and fireclay baffle plates backed and supported by common brick. These furnaces are fired with wood, coal, gas or oil or any combination of these fuels. Ore is fed at the top of the furnace and the sinter is drawn off at the bottom after the metal has been completely extracted. The volatile mercury fumes pass from the furnace to a condenser system where they are condensed to the liquid metal, which is drawn off, cleaned, and bottled in iron flasks.

There is one 12 ton Nichols-Herreschoff multiple hearth furnace in operation in the district. This furnace is the most efficient and modern in design obtainable. This plant uses a vitrified tile condensing system, is oil fired and yields a fairly clean product. In this installation about three barrels of crude oil are used to smelt 12 tons of ore.

The Study Butte mine uses a 30 ton Gould or Cottrell rotary furnace. This is oil fired, has an iron pipe condensing system, and gives good recovery, but the product is not clean as that of the Nichols-Herreschoff furnace. This furnace can be fabricated at any good iron works.

The advantages of the Nichols-Herreschoff compared to the rotary furnace are: (1) higher fuel economy, (2) cleaner product, and (3) long-life of brickwork. The amount of labor required for operation is about the same for both of these furnaces.

VALUES

The amount of mercury in the ore is given either in percentage or in pounds per ton. The liquid metal is shipped in iron bottles, called flasks, which contain 76 pounds of mercury. Market quotations are given in dollars per flask of mercury.

As stated before the average grade of the ore here, for 1936, was 1.2%. This would be 24 pounds of mercury per ton, and at a price of $76.00 per flask the ore would contain $24.00 of the metal per ton.

There is a tariff duty on imported mercury of $19.00 per flask, or 25 cents per pound. In 1936 the imports were 18,088 flasks and the domestic production was 16,569.° Domestic production is, and has been since 1922, less than one half of the domestic consumption.

° United States Bureau of Mines, Mineral Market Reports No. M.M.S.547.

NEW USES FOR MERCURY

Recently the Emmet mercury boiler has been perfected and is now on the commercial market. The two 20,000kw. plants erected in 1933, one in New Jersey, and the other in Schenectady at the General Electric Company, required 300,000 pounds each. Thus the two plants together took about half of this country's annual production. The thermal efficiency of these new boilers is one fifth higher than that of steam boilers, and they all operate at a much lower pressure than the steam boiler. However, the investment in the liquid metal is not excessive compared with the operating economy effected. The Schenectady installation required $300,000 worth of mercury at the prevailing price in 1933, but the entire plant cost $4,000,000. The vaporization-condensation cycle is complete-there is no loss at all in the perfected equipment.

In times of war mercury rises to the prominence of an indispensable key metal. It is used to make fulminate of mercury, the usual detonating agent for explosives. The quicksilver mines are then classed with munitions plants and are protected by troops. However, with the new uses being developed each year for mercury war time prices are not needed to make the mining of quicksilver a profitable enterprise. It is a metal always in demand and one that always brings a good price, there being a ready market for it at all times. For other uses see Exhibit IV.

<u>PRODUCTION IN THE TERLINGUA DISTRICT</u>

CHISOS MINE:

At present this is the largest operating mine in the District, and has operated steadily for about 30 years. "The Chisos mine employs 150 men. The mine, which is the biggest producer in the District and the second largest quicksilver mine in the world, had a record-breaking year in 1915, producing 1,200 flasks of Mercury in November and December; yearly output not available. Produced 500 flasks per month in 1918, with a similar output in 1919 and 1920. In 1921 the output was 3,132 flasks, and the mine was the largest producer in the United States; in 1922 over 2,500 flasks and somewhat more in 1923. No later figures available, but production has been steady. The total is over 110,000 flasks".°

During the World War the United States Government took control of the Chisos mine and built a 100 ton furnace on their property, and set the price at $110 per flask.

RAINBOW MINE:

This mine commenced operations in 1928, and has produced about $600,000 in quicksilver. The depth of the workings are about 650 feet.

°From the Mines' Handbook for 1931.

MARIPOSA:

Here are some of the oldest workings in the District. Fissure veins outcrop over a large area. This property has not been operated for many years. However, it is stated that these workings produced 40 flasks per day for a 20 year period. Part of this property is now being operated by interests said to be associated with the Chisos Company, and at present the main production of Chisos comes from these old workings, which are known as California Mountain.

STUDY BUTTE:

This consists of the Big Bend and Dallas mines. The ore occurs in shrinkage cracks in an intrusive sill. Study Butte has a capacity of 30 tons per day, and has some production. At present they are drilling to prove the extent and value of the ore bodies.

WALDRON MINES:

This Company is producing from old workings and is sinking a shaft 400 feet deep on Section 248. This company is known to be a fair sized producer but its yearly production is not on record.

There have been numerous other small producers in the District from time to time but no attempt has been made to cover them in this report. The blue print, Exhibit III, shows the locations of these properties. The producing mines are shown in green tint.

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xxxx

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1. Schuette, C.N., The Occurrence of Quicksilver Ore Bodies: Am. Inst. Min. and Met. Eng., 139th meeting, February 1930.

2. Schuette, C.N., Quicksilver: The United States Department of Commerce, Bureau of Mines Bulletin 335, 1931.

3. Ross, C.P., Progress Report on the Examination of the Terlingua Quicksilver District, Brewster County, Texas: University of Texas, Bureau of Economic Geology-Mineral Resource Circulars No. 7, April 1934.

4. "The Anticlinal Theory as Applied to Some Quicksilver Deposits" University of Texas Bulletin No. 1822.

5. Mines' Handbook-1931

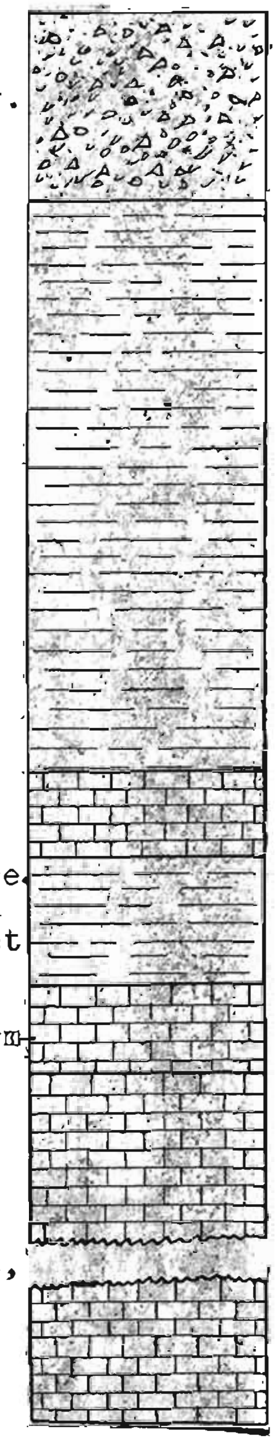
6. Department of Commerce, United States Bureau of Mines Bulletin 1:12 "Mercury in 1931".

7. Department of Interior, United States Bureau of Mines Mineral Market Reports No. M.M.S. 547 "Mercury Industry in 1936-Advance Summary".

ILLUSTRATIONS

GEOLOGICAL SECTION OF FORMATIONS IN THE TERLINGUA DISTRICT

OF TEXAS NEAR THE CHISOS MINE.



CRETACEOUS PERIOD

Taylor Marl formation: approximately 200 feet thick. Forms the surface of the LeRoi property.

Eagle Ford formation: About 600 feet thick. Bottom part is sand and shale. Cinnabar found here. The Chisos is in 400 feet of the Eagle Ford.

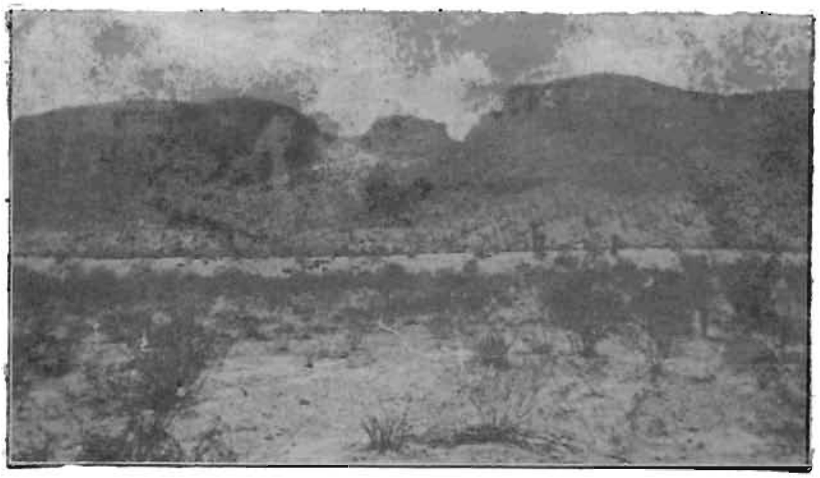
Buda formation: Forms capping for the Del Rio clay; 50 to 70 feet thick. No cinnabar here. Chisos goes through 50 feet of the Buda.

Del Rio formation: 150 feet thick. Cinnabar here. Where the greatest deposit of cinnabar are found here in the Chisos. Chisos works through 150 feet of this formation.

Georgetown formation: 100 feet thick. Cinnabar found. Chisos works through 50 feet of this formation. Rich ore found here.

Edwards formation: 1,000-2,000 feet thick; The Chisos is working in 150 feet of the Edwards, and new and rich ore bodies are being opened up here.

EXHIBIT I



Photograph Showing Outcropping of Large Calcite Veins.

The veins are indicated by the notches in the ridge. The light colored debris below the left notch is weathered calcite.

EXHIBIT II

Map of District Showing Locations of Producing Properties

EXHIBIT III

The producing mines are shown by the green tint.

WELLER PROPERTY
WALDRON PROPERTY
DUNCAN PROPERTY
WALDRON PROPERTY
ALPINE MINING CO.
DUNCAN PROPERTY
Golondrina Mines
ALPINE MINING CO
MITCHELL GILLETTE PROPERTY
CHISOS MINING CO
ALPINE MINING CO.
WALDRON MINES
TARRANT MNG. CO.
TARRANT MINING CO.
WALDRON MINES
WALDRON PROPERTY
TARRANT MINING Co.
HOPSON PROPERTY
TARRANT MINING CO.
Golondrina Mines
PROPERTY
CHISOS MINING CO.
Calif Hill
WALDRON MINES
STARR & WELLER
ALPINE MINING CO.
TARRANT PROPERTY
CHISOS MINING CO.
CHISOS MINING CO.
AMERICAN QUICKSILVER Co.
N
AMERICAN QUICKSILVER Co.
AMERICAN QUICKSILVER Co.
RAINBOW MINES
Shaft
TERLINGUA
CHISOS MINING CO.
Chisos Shaft
TRANS PECOS MINING CO.
Keystone Group
AMERICAN QUICKSILVER Co
WALDRON MINES
CHISOS MINING Co
AMERICAN QUICKSILVER Co
STUDY BUTTE MINES
WALDRON MINES
LE ROI PROPERTY
CHISOS MINING CO.
CHISOS MINING CO.
AMERICAN QUICKSILVER Co
AMERICAN QUICKSILVER Co.
SCALE 1 2" = 1 MILE

PURPOSES FOR WHICH QUICKSILVER WAS USED IN THE UNITED STATES IN 1928 °

USE DRUGS AND CHEMICALS:	Number of flasks (Flask is 76 lbs.)	
Pharmaceuticals	5,493	
Dental preparations	362	
Chemical preparations	7,486	
Seed disinfectants	365	13,706
Fulminate	6,587	
Vermillion	2,450	
Felt manufacture	1,720	
Amalgamation	453	11,210
ELECTRICAL APPARATUS:		
Lamps	1,200	
Rectifiers and oscillators	230	
Primary and storage batteries, battery zincs and standard cells	911	
Rectifier bulbs and power control switches	215	2,556
INDUSTRIAL AND CONTROL INSTRUMENTS:		
Vacuum pumps	115	
Heat control devices	204	
Compensating clock pendulums	32	
Gas pressure and tank gauges	565	
Gas analysis	62	
Flow meters	284	
Thermometers, barometers and miscellaneous scientific instruments	146	
Industrial control apparatus not definitely specified	1,588	2,996
General laboratory uses		628
Manufacture caustic soda and glacial acetic acid		1,000
Various uses: Emmet boiler, boiler compound, fireworks, wood preservative, anti-fouling, paint, and 100 flasks miscellaneous		2,846
Total		34,942

° From Bulletin No. 335 on "Quicksilver " by C. N. Schuette, W. W. Department of Commerce, Bureau of Mines.

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EXHIBIT LV