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**SAMPLING AND ESTIMATION
OF ORE DEPOSITS**

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In an excellent summary of practice in the district, Netzeband⁶ has presented data on the long-hole drilling done by seven leading companies. Tripod mounting is generally used, except in low headings where columns and crossbar can be handled easily. Costs have ranged from \$0.60 to \$1.90 per foot and have averaged \$1.28; results have been gratifying, in the main, although very loose ground and inexperienced runners have resulted in poor showings in some instances. With regard to the value of samples, the author states that:

It has been the experience of the district that no great reliance can be placed on the actual values found in the cuttings; to be of value the cuttings and the operation of the machine must be watched by a competent person. It is probably for this reason that many of the operators did not get really satisfactory service from their machines. Fairly accurate results can be obtained when the pitch of the hole is at a low angle, for practically all of the cuttings can then be saved, but when the hole is drilled at a steep angle and the collar of the hole is very far from the floor it is a rather difficult feat to catch all of the cuttings. As a result cuttings from such a hole are not accurate as to the zinc or lead content, but a careful study of the cuttings will usually tell a competent observer whether or not a mineable ore body is indicated.

Southeast Missouri.—In the Southeast Missouri lead district long-hole exploration has been attended with good results. Details of the earlier practice have been described by Poston.⁷ Some 75 holes averaged 35 feet in depth, the deepest one of 78 feet being inclined 5° above the horizontal. One man averaged 35 feet per shift, mostly with holes 30° up or down; labor cost on a contract basis was about \$0.16 per foot.

IRON MINES

Menominee range, Mich.—On the Menominee range deep holes are used to outline or determine the commercial limits of ore bodies. The ore is rather soft hematite between ferruginous slate foot and hanging walls. Interbedded ferruginous cherts are hard and abrasive. With regard to deep drilling, Eaton⁸ states as follows:

In "deep-hole" drilling a large hammer drill with a powerful independent rotation is mounted on a cross arm between two columns, and the hole is drilled at a slight angle upwards, using standard cross bits of large diameter. As the hole is deepened, hollow extension rods are screwed on the drill steel. Water under high pressure is forced through the rods and bit, and brings back the cuttings, which are caught in a sludge box. Care must be exercised to prevent too much loss of gage in the bit, as this limits the depth to which the hole can be drilled.

Hanover mine, Fierro, N. M.—Excessively hard ground was responsible for high costs at the Hanover Bessemer property, Fierro, N. Mex. Here the ore is massive magnetite and the country rock a metamorphosed limestone rich in hard silicate minerals. Kniffin⁹ summarizes results as follows:

Deep-hole drilling by the use of mounted Leyner machines with sectional drill steel was used for prospecting for a time. These holes proved more expensive than diamond drilling, and the information was not as reliable.

⁶ Netzeband, W. F., *Prospecting with the Long-Hole Drill in the Tri-State Zinc-Lead District*: Min. and Met., June, 1930, pp. 295-296.

⁷ Poston, Roy H., *Leyner Drill in Underground Prospecting*: Eng. and Min. Jour. Press, vol. 118, 1924, pp. 856-857.

⁸ Eaton, Lucien, *Mining Soft Hematite by Open Stopes at Mine No. 1, Menominee Range, Mich.*: Inf. Circ. 6180, Bureau of Mines, 1929, pp. 3-4.

⁹ Kniffin, Lloyd M., *Mining and Engineering Methods and Costs of the Hanover Bessemer Iron & Copper Co., Fierro, N. Mex.*: Inf. Circ. 6361, Bureau of Mines, 1930, p. 6.

The method is now seldom used. The cost of this work per foot drilled for 836 feet was as follows:

Cost per foot of deep-hole drilling

	Labor	Supplies	Repairs	Air	Total
Drilling.....	\$0.877	\$0.609	\$0.524	\$0.449	\$2.459
Sharpening.....	.161			.008	.169
Moving.....	.179	.014			.193
Total.....	1.217	.623	.524	.457	2.821

The couplings and other equipment were carefully made, and the high cost is attributed to the hardness of the rock and ore. The average advance per shift was only 8.84 feet.

GOLD AND SILVER MINES

Tonopah district, Nevada.—In the Tonopah district deep-hole drills have proved very effective. As described by Brown,¹⁰ the machines were employed in prospecting virgin ground adjacent to underground workings; to find faulted ore; or to sample known veins beyond existing openings. Two holes at 10° above the horizontal determine the strike of the veins, while a third inclined 30° upward permits calculation of the dip. Practice in sampling holes at this property has been discussed (p. 60). The following detailed record of the work for November, 1925, is of interest:

	Shifts	Hours	Per cent		Shifts	Hours	Per cent
Moving.....	7	6	9.04	Cleaning hole.....	2	1½	2.40
Drilling.....	68	3	79.73	No air.....	0	5	.73
Fishing.....	3	4	4.08	No water.....	2	1½	2.40
Machine maintenance and repair.....	1	3	1.62		85	6	100.00

Total feet.....	2,345
Average feet per shift.....	27
Feet per drill-shift.....	34
Average feet per bit.....	6.4

Bits	Gage	Footage	Bits	Gage	Footage	Bits	Gage	Footage
1 19	3½	55	49	2½	278	9	2¾	57
83	3¼	643	33	2¾	223			
65	3½	419	28	2¾	236	365		2,345
58	3	293	21	2½	141			

¹ Rose.

Holes are usually drilled at plus 10° inclination, since at that angle they clean themselves of sludge.

Spring Hill mine, Helena, Mont.—At the Spring Hill mine the ore is an extremely hard mixture of pyrrhotite, pyrite, marcasite, and arsenopyrite, carrying native and combined gold, with lime silicate minerals abundant in the gangue. The walls, marbled limestone,

¹⁰ Brown, R. K., *Exploratory Deep-Hole Drilling*: Comp. Air Mag., vol. 31, April, 1926, pp. 1593-1594.

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