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# Unwatering Carson Lake

By L. D. Davenport*

*SYNOPSIS—Carson Lake on the Mesabi range covered desirable orebodies. To make these available for mining, the Oliver Iron Mining Co. pumped out the lake and filled the basin with surface stripping.*

Carson Lake was situated in Sec. 10, T. 57 N., R. 21 W., 2½ miles southwest of Hibbing, Minn., and recently has been unwatered to make the ore below its basin available for mining. The work presented conditions seldom encountered in the preliminary work of opening underground mines on the Mesabi range.


A Mud Island Pushed Up by North Dump


Pumps, Discharge and Rafts, Carson Lake

### Conditions to Be Met

In July, 1913, the engineering department of the Oliver Iron Mining Co. made a report showing the results of work done to determine the feasibility of draining the lake by deepening the natural drainage channel; the quantities involved in unwatering the lake by pumping; and the ditches, culverts and flumes required to drain the surface and mine water permanently from the lake basin. Following is a portion of the report:

"The present elevation of the lake is 916.4 ft., Lake Superior datum, and it is 28 ft. deep at its deepest point. The water draining out of the lake from the southwest corner flows southwesterly for about ¾ mile, when the stream widens out into Snowshoe Lake and Kelly Lake. The elevation of the surface of the water in Snowshoe Lake is 913.4 ft., with a maximum depth of about 10 ft. The stream joining these two lakes with Carson Lake has, therefore, a fall of only 3 ft. or a grade of approximately 0.07%. It is from 8 to 10 ft. wide, 12 to 18 in. deep, and sluggish and irregular in its course."

Following the route of the creek for approximately 2¼ miles south of Kelly Lake, the elevation of the water was found to be 906.4 ft., making a total fall from the surface of Carson Lake to the creek, at this point, of 10 ft. in a distance of about 3½ miles. For the next 1000 ft. the water flows through a cut made for it. This cut is from 4 to 10 ft. deep. The Great Northern Ry. pumps water from Kelly Lake to supply its locomotives. From a consideration of these facts, it was thought impracticable to go further into the matter of draining the lake by deep ditching.

The lake contained at its original elevation of 916.4 ft. the following quantities of water:

| Elevation | Gallons | Elevation | Gallons |
|---|---|---|---|
| 910-916 | 129,470,000 | 890-895 | 7,600,000 |
| 905-910 | 76,190,000 | Below 890 | 1,360,000 |
| 900-905 | 44,850,000 | | |
| 895-900 | 20,930,000 | Total | 280,400,000 |

As shown on the map, two ditches were dug to divert the surface water from the lake basin and to handle the water from the surrounding mines. No. 1 ditch on the west side of the lake was required: First, to catch the natural drainage from rainfall on about 200 acres of land west side of the lake was required, first, to catch the of about 800 gal. per min. from a lake a mile north which is artificially impounded by waste dumps from openpit stripping—this lake has an area of about 100 acres and drains an additional area of 600 acres; third, to carry the discharge from the Leetonia shaft situated at the northwest corner of Carson Lake—this flow was about 800 gal. per min. No. 2 ditch was required—first, to catch the

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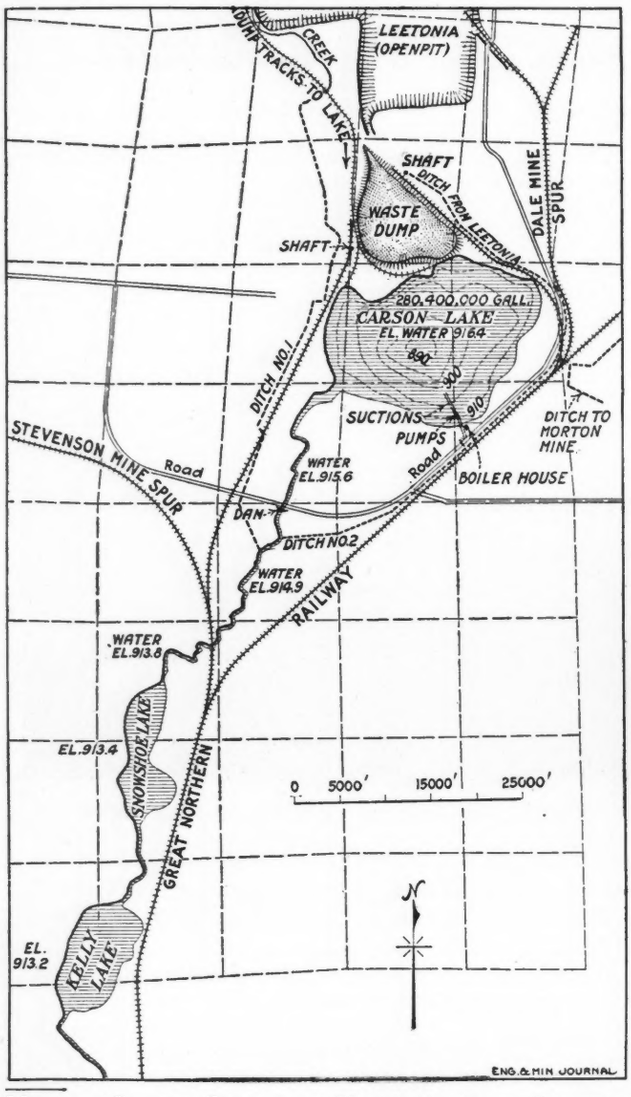
discharge from the north shaft of the Leetonia mine, about 400 gal. per min.; second, to catch the natural drainage from about 30 acres of land east of the Leetonia dump; third, to carry the water which formerly flowed into the lake through a culvert under the Leetonia and Dale mine spurs near the Great Northern main line—this amounted to about 4500 gal. per min. and came from the Morton, Agnew and Utica mines, together with the natural drainage from a considerable area east and north of the lake. Both ditches were dug by contract, the total excavation amounting to about 22,000 cubic yards.




MAP OF CARSON LAKE AND VICINITY WITH GENERAL DRAINAGE LAYOUT

The pumping plant was placed on the south shore of the lake where the ground is low, with sand immediately below a few inches of soil. One 66-in. by 12-ft. firebox boiler and one 60-in. by 14-ft. steam-shovel boiler furnished steam for the pumps. Two Morris centrifugal pumps, rated at 2500 gal. each, with 12-in. suctions, discharged through 10-in. pipes into a tank of 3-in. plank, sunk level with the ground. From this tank the water flowed through three corrugated-iron culvert pipes under the road and into No. 2 ditch. A No. 9 Cameron pump primed the centrifugal pumps. To handle the suctions, two 16x32-ft. rafts were made of timber, covered with 2-in. plank. These rafts were not sufficiently buoyant, so the plank was covered with tar paper together with a layer of matched pine flooring, and sides 3 ft. high were added, forming square-sided scows. A third scow, 10x16 ft., was built and fitted with a short gin pole at its center to raise the suctions.

The two 32-ft. scows carried the last 30 to 40 ft. of the suction pipes, that section having been connected to the main line with a swinging joint. When the scows were moved ahead, the additional pipe inserted behind them was supported on cribs made of old railroad ties.

For measuring the discharge from the pumps, two sets of pitot tubes were made and installed near the boiler house. A curve was worked out so that by measuring the difference in elevation of the water in the gage-glasses of the tubes, the discharge in gallons per minute could be picked off.

The water flowing into the lake was diverted into the ditches on June 29 and the lake level was lowered by natural drainage to an elevation of 915.88 ft. on July 1, when the outlet was dammed and the pumps started. Beginning in May, surface material from an openpit was dumped in the lake from the north and west sides. Much trouble was encountered through the dump's settling sud-


CARSON LAKE PUMPING PLANT, JULY 8, 1914

denly. The soft silt and blue clay of the lake bottom in some cases were forced above the lake surface by the weight of the dump. These mud islands usually appeared from 100 to 300 ft. from the edge of the dump. After the water had been lowered about 10 ft., less trouble was experienced with the dump. The intention is to fill the lake basin with stripping material to a height of about 4 ft. above the original water line.

The draining of the lake was completed in November. The centrifugal pumps were used until the water was extremely low, then a shaft was dropped through the mud to the gravel and a small pump placed in the shaft to drain the mud as much as possible. The shaft was 52 ft. deep, 6x8 ft. inside, cribbed with 8-in. round timbers and covered on the outside with a double layer of boards with the joints broken. About the middle of November, however, the pressure of the soft mud, due probably to the weight of the waste dump, caused the shaft to crush about 35 ft. below the collar.

# Modern American Rock Drill--IX

By L. O. Kellogg

*SYNOPSIS—Cleveland Rock Drill Co. now bringing out new line of stopers using new valve and provided with reservoir back of valve to insure adequate air supply. One model has rotation mechanism in front head similar to Mucker plugger machine.*

As was the case with the Sullivan company, the Cleveland Rock Drill Co. has just brought out some new models in hammer machines which require description here in a separate installment of this series of articles. The machines are stopers, one nonrotating and one rotating. The nonrotating model is interesting for certain changes in details of design, while the rotator is important as being among the first two or three brought out in this country, and probably the first in which the rotation is effected separately from the reciprocation or striking, this being done in approximately the same way as in the Cleveland Mucker drill.

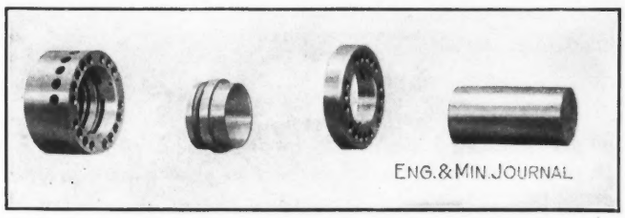
The nonrotating stopers are designated as 2S and 4S. The rotator is 2SR. The principal dimensions and weight of the machines follow:

| | 2 S | 4 S | 2 SR |
|---|---|---|---|
| | Inches | Inches | Inches |
| Length over all, air feed closed..... | 54 | 54½ | 55 |
| Air feed piston rod travel ..... | 24 | 24 | 24 |
| Piston stroke ..... | 3½ | 3½ | 3½ |
| Piston diameter ..... | 2 | 2½ | 2 |
| | Pounds | Pounds | Pounds |
| Weight complete ..... | 80 | 100 | 102 |

The two principal innovations on the nonrotating machines are the air reservoir provided directly back of the valve, and the valve itself which is of a type believed to be here used for the first time.

## The Valve

The valve is a sleeve valve, inasmuch as it is so set at the back of the cylinder as to allow the hammer, which is of uniform diameter, to pass through it on its return stroke. The valve is set in a valve block, or box, and a valve cover, or button, which themselves occupy the rear end of the drilling cylinder, or more properly speaking, are set between the drilling cylinder and the back head of the machine.




Valve Block Valve Valve Button Piston

Disassembled Parts of Valve Action

Since this valve is new, its operation is interesting and may be followed through here in some detail. The supply of air is taken in through the throttle valve shown in the section; in drilling position, the air is admitted through the ports in the throttle valve and the bushing surrounding it to the reservoir in the back head. From the reservoir it passes through the port *A* to the circumferential port *B* in the back head, which communicates with the port *C* in the valve block. These ports communicate with the circumferential port *D*, which is alternately covered and uncovered by the valve in its reciprocation. Another longitudinal port *E* also communicates at the back with the groove *B* in the back head and by means of the radial ports *F* and *G* communicates with the cylinder and with the pressure face *H* of the valve itself. Thus the ports *G* and *F* always are subject to live-air pressure.

With the valve in the position shown, live air is passing through the ports indicated to the port *D*, then around the groove *I* in the valve itself, then through ports *J, K, L, M*, to the front end of the cylinder, thus tending to force the hammer toward the rear. From behind the hammer the air is exhausting through ports *N, O, P, Q, R*, to the atmosphere, and also through the grooves and ports *S, P, Q, R*. As the hammer uncovers the port *G* on its backward stroke, the constant pressure on the valve area *H* is reduced to that of the pressure below the piston chamber. When the hammer travels still farther back and covers the pressure area *T* of the valve, compression is set up between the returning hammer and the back of the cylinder, which acts on the pressure area *U*. This pressure added to that on the pressure area *V* of the valve overcomes the pressure on the area *H* and throws the valve forward.


The New Cleveland Hand-Rotated Stoper

In this new position the valve groove *I* connects the slot *W* in the valve box with the slot *X*, and thus connects the forward part of the cylinder with exhaust, through the ports *M, L, K, W, X, P, Q, R*. Live air is now admitted through the port *C* across the rear face *V* of the valve, to the rear of the cylinder, and acts on the rear of the hammer to start it forward on its useful stroke. When the hammer is in its retracted position, it receives its initial impulse forward by means of live-air pressure communicated through the port *Y* from the reservoir. There is at this time no pressure on the face *H* of the valve, inasmuch as any air flowing to this space through the ports *E* and *F* is exhausted by means of the port *G* to the front end of the cylinder, and thus to atmosphere. When the piston moving forward passes the face *T* of the valve, air pressure is effective on both faces *T* and *U*, tending to

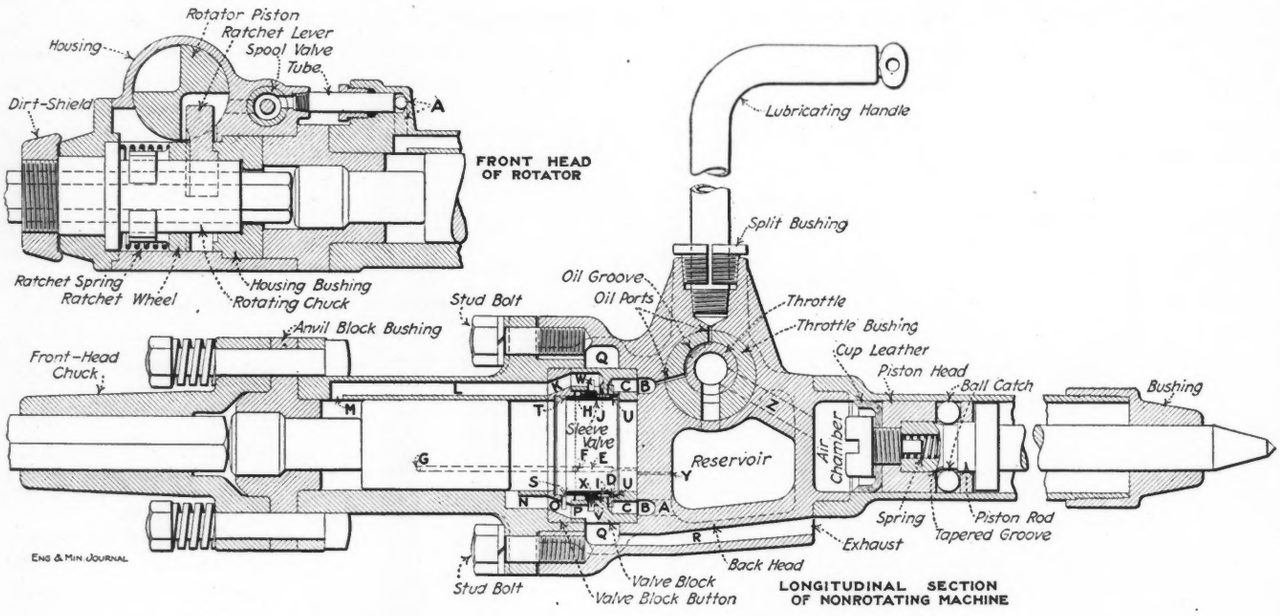
put the valve in a balanced position. As soon as the port *G* is covered by the forward-moving hammer, the live-air supply to the face *H* is no longer exhausted, and the pressure on this face added to that on the face *T* overcomes the pressure urging the valve forward and throws it to the rear.

It will be noted that the cylinder is short and consequently the air ports are short. They are also large, and these features, together with the introduction of the reservoir immediately behind the valve, in which the volume of air is twice that necessary for a stroke, result in furnishing a full supply of air at full pressure during the whole stroke of the hammer, thus adding to the force of its blow and consequently to its drilling efficiency. Wire drawing or throttling is reduced to the minimum.

### Other Features of Machine

It will be noted that the hammer is symmetrical, whereas, heretofore, the Cleveland drills have usually had tube moving with the drilling end of the machine. It is controlled by the throttle valve, air being admitted through the port *Z* to a chamber in the back head, where it subjects the piston of the feed to pressure. When the throttle is shut off, the air in the feed is allowed to exhaust through the leak hole in the throttle valve to the atmosphere, and thus permits the feed to be collapsed.

The locking device for the air feed is unique. The air-feed piston rod has a little play in the piston head. Normally, the two parts are held a little separated by the spring shown. There is a taper groove around the piston rod, which registers with two holes in the piston head. Two steel balls operate in the holes and the groove. With the piston head and the piston rod forced apart by the spring, the effect of the tapered groove is to force the balls out against the outer tube when the piston rod and head move outward, and thus prevent such motion. When the piston rod is pushed inward, however, the balls do not act in the same fashion. When the drill is operating,




Sections of New Models of Cleveland Stopers

unsymmetrical hammers. The front head, or chuck, is bolted to the cylinder with two short through-bolts, having helical springs, and between these two parts is held the bushing for the anvil block. The anvil block itself presents no new features. The back head is held to the cylinder by means of two stud-bolts, which are shown in the longitudinal section, and also by means of two through-bolts, which are not shown. These two through-bolts are set at 90° with the studs, and hold the outer tube of the air feed to the cylinder with the back head set between.

The rotating handle is attached to the back head. It is screwed into the position desired, and then a split bushing screwed down to lock it, as shown. The handle also acts as an oil reservoir. Its inner end communicates through a series of ports to the port *B* supplying air to the cylinder. The series of ports includes a groove in the throttle. When the air is shut off, the ports and the groove are filled with oil, and when it is turned on this oil is discharged into the valve and cylinder.

The telescope feed is of the ordinary type, the outer

the air pressure is on the piston head, while the point of the piston rod is on the rock; these two parts are therefore forced together, partially collapsing the spring which normally holds them apart. This brings the tapered side of the piston-rod groove out of contact with the balls, so that these permit free motion in either direction.

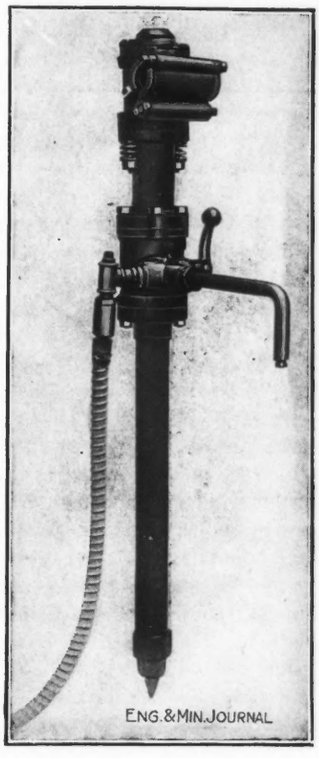
The net result of this is that the air feed is locked in position, wherever it may be, so far as pulling out is concerned, although it may always be run in. And when the air pressure is turned on it can easily move out. The piston head is made tight against the outer tube by the cup leather shown, and the piston rod works through a bushing screwed on the bottom of the outer tube, to act as a bearing.

### The Rotator

The rotating stoper resembles the smaller of the non-rotating machines, except for the rotation itself. The lubrication, valve mechanism, hammer, back head and air feed are identical. The sectional illustration, therefore, represents only the rotating end of the machine. The air

supply passes through the valve block, and the cylinder shell, by means of longitudinal ports, to the forward end of the cylinder, then through the port *A'*, to the tube which communicates with the rotation valve.

The rotation valve and the rotation piston drive a ratchet mechanism identical in principle and similar in design to that used on the Mucker drill and described in part VII of this series of articles. This ratchet mechanism revolves a chuck which, in turn, revolves the steel. A shield is screwed to the end of the revolving chuck to prevent the entrance of dirt. The rotation device is held to the cylinder by means of two through-bolts, which are not shown in the drawing, but which resemble in general the bolts on the end of the nonrotating cylinder, being equipped with helical springs to take up shock.




THE CLEVELAND ROTATING STOPER

The rotating model further differs in its control valve. This is so arranged that either the hammer or the rotator may be operated separately. The control valve has five positions. In the first, no air is admitted to the machine; in the second, air is supplied to the telescope-feed only; in the third, the hammer reciprocates slowly, the rotation being inoperative; in the fourth, the hammer does not operate but the rotation operates slowly; and in the fifth both hammer and rotation operate at full speed.

There is no slip device in the rotating mechanism, since, if for any reason the drill steel becomes jammed too tight to be pulled around by the rotating engine, the valve in the latter simply stalls until the steel is free again to turn. In such a case the ordinary rotating handle is brought into play and the machine rotated by hand until the difficult section of rock is passed through. The advantages of independent rotation in bad ground are obvious.

## Amber

According to the London *Mining Journal,* the war is likely to have a serious effect on the amber trade, as the great bulk of supplies is derived from the deposits in the neighborhood of Dantzig and Königsberg. The production from the Royal amber mines in 1913 amounted to 427 metric tons, as compared with 400 tons in 1912. There is an increasing demand for raw material to the extent of 20%, so much so that the price was advanced by the State Factory at the beginning of 1914. In addition to the ordinary requirements for Europe and America, a good trade is done in amber beads for Asia and Africa. Some amber is found on the Baltic coast in Russian territory in the neighborhood of Libau, and its occurrence has been noticed in various places in Siberia. [There would seem to be a possibility that the war may seriously cripple the amber trade permanently, as we understand that Dr. L. H. Baekland has produced a modification of bakelite that has all the physical and electrical properties of amber and can only be distinguished from it by ultimate analysis.—EDITOR.]

## The Cost of Producing Lead

The recent decline in the price for lead to 3½c., N. Y., which led to curtailment in production by the principal operators both in Missouri and Idaho, gave interest to the discussion of what is the average cost of producing lead in the United States. Bearing upon this subject, the following paragraphs from "Lead and Zinc in the United States," by W. R. Ingalls, published in 1908, are of interest.

**While the tariff wall inclosing the lead industry of the United States remained practically unchanged from 1864 to 1894, the conditions of production in the United States experienced great alterations. From 1871 to 1880, and in the early '80s, the bulk of the domestic lead production came from ores of comparatively high grade in lead and silver, which in spite of high mining and smelting expenses caused the cost per pound of lead to be relatively low, but the producers were handicapped by the long and costly railway carriage on their metal. In 1872 the cost of transporting bullion from Eureka to San Francisco was about 3c. per lb.; in 1874 it was about 1.6c. From Salt Lake to Omaha the cost was 1c. per lb. in 1871; from Salt Lake to Chicago, 1.4c. per lb. in 1872. In 1880 the cost from Leadville to New York was 1.75c. per lb. Until the latter part of the '80s the producers of the West were under such heavy handicaps of freight rates. Even at the present time, when freight rates have come down to extraordinarily low points—0.32c. from Pueblo and Denver, and 0.54c. from Salt Lake City to New York—the Western producers suffer from their distance—2000 to 2500 miles—from the principal markets, the cost of carrying lead from Monterey, Mexico, to New York being only 0.2c. per lb. However, there has been a vast improvement in this respect from the conditions of 1870-1885.**

**But in the meanwhile the ores of high grade in lead and silver have disappeared and it has come to pass that the bulk of the lead production of the United States is obtained from very low-grade ore. It is undeniable that the tariff on lead has raised the price which American consumers have had to pay. It is doubtless true that at certain periods the price has been maintained in this way at figures which have given unnecessary advantage to the producers. But on the other hand it is evident from a study of the history of the industry that the increase in domestic lead production, which has not more than corresponded with the increase in domestic consumption, has been greatly stimulated by the advantage in price which the tariff has bestowed, and moreover, this has fostered not only the lead industry alone, but also the mining and smelting of ores containing the precious metals, which in the absence of an abundant supply of lead ore would have to be worked by less economical methods.**

**It is dangerous to generalize the cost of producing lead for the whole country, or even for a particular district. In the case of southeastern Missouri this can be done with more safety than in any other, because there the only value of the ore is in its lead content, and the grade of the ore mined, conditions of occurrence, and methods of mining are rather uniform throughout the district. In 1882 the cost of pig-lead delivered at St. Louis by the large producers was 3 to 3.5c. per lb.[1] In 1884 the "Engineering and Mining Journal" expressed the opinion[2] that if freights were better adjusted the majority of the producers of the United States could stand a price of 3.5c., or even 3.25c., but the pressure of lead at 2.75c. would be such that as that figure was approached the number of idle mines would increase in geometrical ratio.**

**In 1899 the cost to the principal producers of southeastern Missouri was 2.25c. per lb., delivered at St. Louis. However, none of the figures above given includes interest on the**

[1] Mineral Resources of the United States, 1882, p. 312.
[2] Feb. 2, 1884.

money invested, return of the principal, etc.[3] The purchase of an acreage of land sufficient to warrant development on a large scale, the sinking of shafts and equipment of plant a few years ago would cost about $1,000,000 for a productive capacity of 10,000 tons of pig-lead per annum. Estimating amortization at 10% and interest at 5%, the annual fixed charge would have been $150,000 or 0.75c. per lb. of lead. A total cost of production of 3c. per lb., basis St. Louis, is probably the lowest on record for the southeastern Missouri lead. At present the cost is considerably higher. It is a fact that this lead has been sold at a lower price than 3c., but it has been at a loss, all charges considered.

In a previous chapter, it was estimated that the cost of producing lead in the Coeur d'Alene in 1907 was in the neighborhood of 3.3 to 3.5c. per lb., basis New York delivery; i.e., if the price of lead should be 3.5c. per lb. and the price of silver 50c. per oz. at New York, some of the Coeur d'Alene large producers would realize no profit, even after disregarding allowances for amortization. It would be highly difficult to generalize the capital account in this district, but probably it would not be far out of the way to say that the total cost of producing lead in the Coeur d'Alene is in the neighborhood of 4c. per lb., when silver is worth only 50c. per oz.

The Coeur d'Alene and southeastern Missouri together furnish nearly 60% of all the lead now produced in the United States. The actual cost of this lead has been about 3c. per lb. under the most favorable conditions. The average cost of all the lead produced in the United States is probably considerably higher than that.

There is no question that lead can be produced more cheaply in Mexico, Europe and Australia than in the United States, inasmuch as the price at London for long periods has been lower than 3c. per lb., and the output of the mines is maintained. The superior advantage of the foreign countries is partly in cheaper labor, partly higher grades of ore, which more frequently than in America yield two valuable products, e.g., zinc and lead, as in Australia, and partly to shorter railway hauls. The cost of smelting and refining is as low in the United States as anywhere in the world; the freights on the whole are higher—not per ton-mile, but in the aggregate of miles; the cost of mining per ton of concentrated product is doubtless higher on the whole.

Since the date of the last figures quoted above, conditions certainly have not changed for the worse among the lead producers. In 1912 and 1913 the cost of lead to the Bunker Hill & Sullivan, the leading Cœur d'Alene producer, was about 2.5c. per lb. The cost to the Federal Mining & Smelting Co. in 1913 was about 3¼c. per lb. There are no published data respecting the Hercules, Hecla, Stewart and other important producers, but their figures probably fall between 2½ and 3¼c., and more nearly the former than the latter.

Although the average cost in Missouri is now somewhat higher than it was 10 to 15 years ago, it is not, probably, higher to any great degree. Such increase as there has been is ascribable to the mining of lower grade of ore, yielding less lead per ton and to increased wage-scale. On the other hand, these adverse factors have been almost offset by improvements in mining, milling and metallurgical methods. It seems to be reasonably assured that the Missouri lead costs a little less on the average than the Idaho lead, and that neither the Missouri nor the Idaho producers would fail to meet direct operating expenses even if they should receive only 3c. per lb. for their product, but they would not have anything to make good the wear and tear of their plants and give them a reasonable profit on their invested capital unless they should receive at least considerably more than 3½c. per lb., which price must be uncomfortable to all but the very favorably situated producers. Their willingness to curtail when that figure was reached supports the conclusions herein drawn. Equally clear is it that the big producers must make a great deal of money when lead is at 4c. We can therefore understand why the lead miners maintained their enormous production until the screws were turned against them.

[3]It is utterly misleading to draw conclusions from figures which do not take those factors into account. Producers who are already established may be willing for a time to sell their output at a price which returns only the direct cost, or even less, rather than incur the greater loss of suspending operations, but so long as such a condition exists no new capital will go into a business where the adventurers can not see a return of the principal and a proper interest upon it.

## Precipitation from Cyanide Solutions

Precipitation of metal from cyanide solutions has been accomplished by several different methods since the origination of the process, but those methods which make use of zinc in a finely divided form have been by far the most successful and widely used. Zinc in the form of shavings has been a standard process since the introduction of cyanidation, and has maintained its supremacy in spite of efforts to establish such systems as electrolysis, charcoal, or other metals as precipitants. The two objections to zinc shavings have been the waste of zinc and the inconvenience of handling it. Efforts to avoid those difficulties led to the attempt to use zinc dust.

The first attempt to use zinc dust was unsuccessful because, on account of the failure to remove the precipitate immediately from the solution, re-solution occurred. C. W. Merrill introduced, at the Homestake mill, the process of putting zinc dust into the suction of a pump carrying pregnant solution, and pumping it through a long pipe line and directly through a filter press. This process proved successful.

In an entirely different class are those instances in which recourse is had to make-shift methods, where a problem is to be solved quickly. Such is the canvas-bag system devised at the Lluvia de Oro mill in Mexico, and adopted at the McIntyre, at Porcupine, Ont. This system solved an urgent difficulty cheaply and quickly, and served until a more permanent system could be installed. There are, of course, methods of precipitation using zinc dust which do not conflict with the Merrill patent, and which may or may not be as efficient, but Merrill was the first to solve this problem and make zinc-dust precipitation a commercial success.

## Analyses of Antimony

W. A. Cowan, in a paper presented at the meeting of the American Institute of Metals, Sept. 7-11, 1914, gave the following analyses of ingots of antimony bought in the market, as follows: Cookson's, branded "C"; Hallett's, branded "H"; Japanese, branded MC; and Chinese, branded with two overlapping circles. Each sample was analyzed by two independent chemists. Their results were as follows:

| | Cookson's % | | Hallett's % | | Japanese % | | Chinese % | |
|---|---|---|---|---|---|---|---|---|
| | A | D | A | D | A | D | A | D |
| Lead | 0.041 | 0.102 | 0.669 | 0.718 | 0.443 | 0.424 | 0.018 | 0.029 |
| Tin | 0.035 | trace | 0.175 | 0.012 | 0.175 | 0.012 | 0.035 | none |
| Arsenic | trace | 0.092 | trace | 0.210 | 0.008 | 0.095 | 0.017 | 0.090 |
| Bismuth | ..... | none | ..... | none | ..... | none | ..... | none |
| Copper | 0.040 | 0.046 | 0.038 | 0.046 | 0.034 | 0.043 | 0.008 | 0.012 |
| Cadmium | ..... | none | ..... | none | ..... | none | ..... | none |
| Iron | 0.010 | 0.004 | 0.014 | 0.007 | 0.015 | 0.007 | 0.007 | 0.004 |
| Zinc | trace | 0.034 | trace | 0.023 | trace | 0.023 | trace | 0.027 |
| Ni and Co | ..... | 0.028 | ..... | none | ..... | none | ..... | trace |
| Sulphur | ..... | 0.086 | ..... | 0.128 | ..... | 0.201 | ..... | 0.078 |
| Antimony* | ..... | 99.608 | ..... | 98.856 | ..... | 99.195 | ..... | 99.760 |
| Total | | 100.000 | | 100.000 | | 100.000 | | 100.000 |

* By difference.

It is noteworthy that the Chinese metal contained less of every impurity than the Cookson's, which is the premier brand of the market.

# Report of the Selby Smelting-Smoke Commission

*SYNOPSIS—The report of the Selby Smelter Commission was filed with the Superior Court of Solano County, Calif., Dec. 8, 1914. This report settles finally and conclusively the controversy between the residents of Benicia and adjacent agricultural country and the Selby Smelting & Lead Co. concerning alleged disagreeable and injurious effects produced by the smoke from the Selby smelting works. The commission finds that the Selby company does not violate the court injunction respecting nuisance nor with respect to injury to crops or vegetation through emitting sulphur dioxide into the atmosphere. No damage to animals since installation of baghouse.*

The Selby smelting plant is situated near Vallejo Junction, Contra Costa County, Calif., at the western end of Carquinez Strait. Benicia is in Solano County, at the eastern end of the strait and about five miles from the smelting works.

### Smelting Company Lost the Original Action

On Mar. 14, 1905, action was brought by the district attorney in the Superior Court of Solano County, Calif., praying for an injunction which would restrain and enjoin the Selby Smelting & Lead Co. from permitting injurious smoke and gas from the Selby smelting works to blow over and upon the city of Benicia and the tributary country. The case was brought to trial on Aug. 7, 1906, and judgment of the court in favor of the plaintiff was rendered on July 16, 1908. The decree enjoined the Selby company from discharging noxious gases and fumes into the open air in such manner as to affect Benicia and the tributary country, between Mar. 15 and Nov. 15 of each year. A motion for new trial was denied, and the Supreme Court of California on June 12, 1912, affirmed a judgment of the trial court.

During the period covered by this litigation the Selby company had succeeded in removing the major portion of lead, arsenic and sulphur trioxide from the smoke. In the spring of 1913 complaints were made that a nuisance still existed. Finally, it was agreed between the complainants and the Selby company that the question of fact as to violation of the decree of the court might be submitted to a board of technically trained men. A stipulation to this effect was filed in the record of the case.

### Personnel of the Selby Smelter Commission

On May 22, 1913, the following named were selected and organized as the Selby Smelter Commission: J. A. Holmes, director, U. S. Bureau of Mines; E. C. Franklin, professor of organic chemistry, Leland Stanford, Jr., University; Ralph A. Gould, chemical engineer, San Francisco, secretary of the commission.

The function of the commission was to determine the facts and report its findings on the following: (1) Is the Selby smelting plant operating in such a manner as to violate the decree of the court dated July 16, 1908? (2) If the defendant company is violating the decree, what is the extent of the violation? (3) If the defendant company is violating the decree, what steps must be taken by the defendant to avoid a violation of the decree?

The investigations were made by the following staff of scientific and technical men who had no interest directly or indirectly in the findings of the commission:

A. E. Wells, metallurgist and chief chemist, in charge smelting investigations and field work; C. B. Dutton, special legal agent, U. S. Bureau of Mines; Charles F. Shaw, professor of agronomy, college of agriculture, University of California; E. E. Free, soil expert and agronomist; J. W. Blankinship, plant pathologist; Wyatt W. Jones, plant pathologist; R. W. Doane, professor of entomology, Leland Stanford, Jr., University; C. M. Haring, professor of veterinary science, college of agriculture, University of California; K. F. Meyer, professor of bacteriology and protozoölogy, University of California. Through the courtesy of Dean Thomas Forsyth Hunt, of the college of agriculture, and Prof. F. T. Gay, of the department of pathology, the commission had the coöperation of several of the staff of the University of California. Experts of the U. S. Bureau of Mines, especially Dr. F. C. Cottrell and Dr. L. H. Duschak, rendered assistance.

### Subjects Investigated

The results of the investigations were presented to the commission in the form of reports as follows: (1) A detailed study of statements of residents of the Selby "smoke zone" as regards the presence of a nuisance, by C. B. Dutton. (2) Conditions in and around the smelting plant and the "smoke zone," by A. E. Wells. (3) Investigations to determine the extent of contamination of the atmosphere by smelting emanations, by A. E. Wells. (4) Investigations to determine the sulphur dioxide present in the atmosphere in places outside the "zone," by A. E. Wells. (5) Conditions of plant life, by J. W. Blankinship. (6) The occurrence of sulphur-dioxide injury to plants, by Wyatt W. Jones. (7) Insect pests, by R. W. Doane. (8) Agronomic and soil conditions, by Charles F. Shaw. (9) Investigation of live-stock conditions and losses, by C. M. Haring and K. F. Meyer. (10) Fumigation experiments to determine the effect of highly diluted sulphur dioxide upon a growing grain crop, by A. E. Wells. (11) Investigations to determine the effects of sulphur dioxide on man, by A. E. Wells. (12) Possibility of reducing the sulphur-dioxide output from the Selby plant: (a) Investigations of the gases from the Dwight-Lloyd sintering machines of the Selby works; (b) studies in the commercial utilization of the sulphur dioxide produced by the Selby works, by A. E. Wells. (13) Bibliography: The effect of sulphur dioxide on vegetation and animal life, the Chemists' Club Library, New York.

### Effect of "Smelter Smoke" on Residents Largely Imaginary

The field investigations on which these reports were based were conducted between June, 1913, and September, 1914. Mr. Dutton's report showed that two classes of odors have been described by residents of the "smoke zone" as "smelter smoke." One was found to be due to sulphur dioxide; the other due to certain products from the refining of petroleum, the so called "oil smell," which

NOTE—Condensed from a statement, prepared by the commission, reviewing the facts and the findings presented in the report filed with the Superior Court of Solano County.

up to 1910 or 1911 was present at times in the form of fumes and gases which could not possibly have been due to smelter emanations. Subsequent to 1911 "oil fumes" have not been so prevalent, but occasionally the odor of sulphur dioxide has been detected. The conclusions from Mr. Dutton's report are that among the greater proportion of the residents there is at present only slight if any legitimate objection to the presence of smelting smoke in the atmosphere in the "smoke zone," and that the occasional presence of smelting smoke occurring under unfavorable conditions does not prevent enjoyment of life and is not detrimental to health.

### Over 5000 $SO_2$ Determinations

Investigations for the direct determination by chemical analysis of the sulphur dioxide contained in the atmosphere were conducted by A. E. Wells, with the assistance of eight trained chemists and six helpers. The commission believes this to be the most extensive and exhaustive of its kind. For the determination of sulphur dioxide, a method has been developed which is believed to be by far the best yet used in work of this character, in that it combines in a most satisfactory manner those characteristics which permit "instantaneous sampling," rapidity of execution, easy field manipulation, and high degree of accuracy. Concentrations of sulphur dioxide as low as 0.2 parts per million of air are rapidly and easily determined by the method as developed and finally adopted by the commission. For the essential features of the method, the commission is indebted to J. R. Marsden, chief chemist of the Selby works. For making observations in the field, two permanent laboratories were established, where sulphur-dioxide determinations were made at brief intervals daily, and an automobile was equipped as a portable laboratory, by means of which determinations were made in all parts of the "smoke zone" as well as in many places outside.

The field investigations to determine the sulphur-dioxide content of the atmosphere extended from Sept. 17 to Dec. 15, 1913, and from Mar. 1 to Apr. 15, 1914, during which time 4862 determinations were made in the Selby "smoke zone" and 700 determinations were made in places outside.

During the entire course of the investigations especial attention was given to the metallurgical processes going on at the smelting works, and the amount of sulphur dioxide from the plant during the tests was checked. Determinations were made when wind conditions were the worst possible for the area, and when, at the request of the commission and under its supervision, the output of sulphur dioxide was the highest possible. Other tests were made with the smelting works entirely closed down, and with the wind conditions favorable and unfavorable. Every attempt has been made to obtain maximum, average and minimum figures as to the sulphur-dioxide content of the atmosphere.

### Most Determinations Showed Less than 0.2 Part $SO_2$ per Million of Air

Of the total number of "instantaneous" samples (4862) taken in the Selby "smoke zone" during the period of field work, 75% contained less than 0.2 part $SO_2$ per million of air; 86% contained less than 0.4 part $SO_2$ per million; and over 97% contained less than 1 part $SO_2$ per million parts of air. Only 21 samples, or 0.43% of the total, contained more than 2 parts $SO_2$ and no sample analyzed more than 7.1 parts $SO_2$ per million.

The higher concentrations were found only when puffs of the smoke from the smelting works were drifted by a gentle breeze over the most exposed portions of the "smoke zone," and at no time did a concentration greater than 2 parts $SO_2$ per million persist for a continuous period of more than 30 min. The total time during the whole period of the commission's investigation that the concentration of sulphur dioxide was more than 2 parts per million at any part of the "smoke zone" was 220 minutes.

Only on six occasions was the concentration above 3 parts $SO_2$ per million, and the total time that the concentration was above that amount was 65 min. Within the city limits of Benicia, the maximum concentration of sulphur dioxide found was 2.4 parts per million, and only 22 out of the 2840 samples taken in this portion of the "smoke zone" contained more than 1 part $SO_2$ per million.

### Higher $SO_2$ in San Francisco

In the business section of San Francisco during calm mornings, the concentration of sulphur dioxide was found to be as high as 1.8 parts $SO_2$ per million. Under brisk wind conditions, as are prevalent during the late morning and early afternoon during the period of trade winds, the sulphur dioxide content was seldom over 0.2 part $SO_2$ per million. On the ocean beach no determinable quantity of sulphur dioxide was found. In Oakland and Berkeley, of the 148 determinations made, none showed a concentration of sulphur dioxide higher than 1 part per million. In the vicinity of Richmond, 103 determinations were made which showed an average value of 1.1 parts $SO_2$ per million, and a maximum content of 4.5 parts $SO_2$ per million. In Martinez and vicinity, 168 determinations were made. The average of these determinations was 0.23 part $SO_2$ per million, and the maximum 1.7 parts $SO_2$ per million.

The results of these investigations show that, on the one hand, although the atmosphere of other areas investigated shows a higher constant concentration of sulphur dioxide than the Selby "smoke zone," the maximum concentrations in the Selby zone, on the other hand, are higher than any of the other areas investigated. These higher concentrations, however, never persist for more than a few minutes.

### "Smoke Zone" Residents Unable to Detect One Part $SO_2$ per Million

In order to determine whether the concentration of sulphur dioxide found in the "smoke zone" was sufficient cause for nuisance complaint or could be injurious to health, it became necessary to study the effects of high dilutions of sulphur dioxide upon man and to determine the sensitiveness of various persons to the gas. Sixty subjects were experimented upon, 32 of whom were previously acquainted with the gas, and no one was able to detect the presence of 1 part $SO_2$ per million of air. With concentrations of 2 parts $SO_2$ per million, several subjects detected the presence of something foreign in the air, but could not identify it, and two subjects identified the gas by taste. With concentrations of 3 parts $SO_2$ per million, the greater proportion of the subjects acquainted with the gas were able to identify it, and at 4 parts practically all were able to do so. The greater proportion of sub-

jects unacquainted with the gas did not identify it until the concentration was greater than 4 parts per million. As a general statement it may be said that concentrations of 3, 4 and even 5 parts per million were not considered by the subjects to be a nuisance, even if continued for a considerable period of time; concentrations of from 5 to 10 parts $SO_2$ per million if continued 10 to 15 min. would be considered a nuisance; and above 10 parts, if existing for only a few minutes would certainly be called a nuisance. It was definitely determined that concentrations below 3 parts $SO_2$ per million cannot possibly be considered a nuisance or a cause for discomfort.

### Benicia Residents Not Subjected to "Nuisance"

In view of the established facts it is quite impossible to maintain that during the period of investigations by the commission the residents of Benicia or of any other part of the "smoke zone" have been subjected to a nuisance as the result of discharge of sulphur dioxide from the Selby plant.

Extended experiments were conducted to determine whether such concentrations of sulphur dioxide as are found in the Selby "smoke zone" are capable of doing any injury to crops or other vegetation. Barley plants were allowed to grow normally in an open field and occasionally for definite periods the plants were subjected to definite concentrations of sulphur dioxide. The object was to determine: (1) The visible injury produced; (2) the economic injury or decrease in yield resulting from the visible injury produced; (3) a possibility of "invisible injury" to a growing grain crop and the extent to which this may take place.

In a field of growing barley, experimental plots 4x20 ft. in area were laid out and covered during periods of fumigation with a cabinet so designed as to interfere as little as possible with the illumination of the plot. The sulphur-dioxide-and-air mixture was blown in at one end and allowed to escape at the other, in such a way as to maintain a steady stream of air containing sulphur dioxide through the cabinet during the fumigation periods. The length of time of each fumigation varied between two minutes and one hour. Simultaneously, experiments were carried on, on 106 plots near Vallejo and 35 plots at the University farm at Davis, with results which were concordant in every respect.

### $SO_2$ Limits for Growing Plants

A concentration of 5 parts sulphur dioxide applied for an hour under ordinary humidity conditions produced considerable visible injury. Visible injury is produced on growing barley by concentrations of 1 part $SO_2$ per million of air if the length of time of application is sufficiently great. Thus, three fumigations of 7 hr. each produced slight visible injury and no reduction in yield, with air containing 1 part sulphur dioxide per million. Sixty-two fumigations of one hour each, with 0.5 part $SO_2$ per million, irregularly continued through the growing period, produced very slight visible injury and no reduction in yield.

### No Economic Damage to Plants

The commission has found that from time to time conditions may arise under which slight visible injury will be visited upon susceptible plants growing on the more exposed portions of the "smoke zone." Since, however, plants will endure a considerable amount of visible injury without any diminution of crop yield, the commission concludes that within the "smoke zone" no economic damage results from the smoke of the Selby smelting plant. This conclusion received convincing confirmation from the observations of the commission's plant pathologists, who have found no indications whatever of economic sulphur-dioxide damage within the area of the "smoke zone."

A number of plots badly bleached in the early stages of growth were observed to recover rapidly and their yield at maturity averaged within 3% of the yield from the check plots. Short-time fumigations repeated a great many times, and of sufficient intensity to keep the foliage bleached throughout the season, were much more effective in reducing the yield than were one or two very strong fumigations. No economic damage or loss as expressed in decreased yield of crops or decrease in the fertility of the seed resulted from the treatment.

### Poor Yields in "Smoke Zone" Due to Neglect

For the determination of the condition existing in the "smoke zone" regarding crops of various kinds and the many kinds of plant life found in the zone, two plant pathologists of a high degree of training and extensive study were employed. The only conclusions which can be drawn from their survey are that such poor conditions of plant growth as exist are directly traceable to one or more of the following causes: Plant diseases, predacious insects, poor soil, poor cultivation, lack of water, and indifference to all these conditions by the farmers of the area. None of the conditions existing, so far as vegetation is concerned, can be attributed to the effects of the smoke from the Selby smelting works.

The conclusion reached from consideration of the data collected during the entomological survey is that lack of cultivation, lack of proper pruning, absence of spraying and fumigation with insecticides are mainly responsible for the unusually bad condition which exists among the trees, vines and shrubs. The indifference of certain farmers is illustrated by the fact that Professor Doane volunteered advice free of charge and to supervise their attempts at combating insects, yet none of them accepted his service.

The yield of crops is below the average for areas in other sections having the same climate. The poor quality of the soil and poor agricultural practices are sufficient to account for existing bad conditions as to crops and yields. No soil trouble exists other than poor quality, to which the existing conditions as to plant growth can be traced. Samples of soil were taken from various portions of the area and subjected to examination to determine the presence of lead and arsenic. These metals were found to be natural constituents of the soil.

The data collected by Mr. Wells on the presence of lead and arsenic in the air before the installation of the roaster baghouse proved that an amount of lead and arsenic present was unimportant from the point of view of soil contamination.

### Damage to Horses

The veterinary survey included identification of every horse and the enumeration of all the other important domestic animals within the zone; 31 horses out of a total

of 308 were suspected as being of the type known as "roarers;" 12 of the 31 were so diagnosed; the animals so affected breathed with a peculiar roaring sound. In the opinion of the experts this condition was due to chronic lead poisoning and the animals had been injured by smelter smoke.

### Baghouse Now in Use for Roaster Gases

The study of the atmosphere uncontaminated by a visible element of the smoke of the Selby plant was permissible by the fact that at the request of the commission the Selby Smelting & Lead Co. installed a baghouse by which means the visible smoke was eliminated. The installation was requested Oct. 25, 1913, and was completed Apr. 1, 1914, at the expense of approximately $35,000. In order that full information might be at hand upon which to base recommendations for the subsequent operation of the smelting plant in the event a nuisance was found to exist, a commission early undertook certain studies to determine the possibility of eliminating the sulphur dioxide before the smoke is sent into the atmosphere.

Investigation of the operation of the Dwight-Lloyd sintering machines showed that, by a proper preparation of the charge and a recirculation of a part of the gases, 80% of the total sulphur dioxide eliminated by the machines can be concentrated in a volume containing 7.5% sulphur dioxide. With this concentration it is possible to apply a commercial scheme for recovery by the production of sulphuric acid, liquid sulphur dioxide or sulphur.

### No Damage Now by Selby Plant

From personal investigations and study of the various reports the commission finds that the Selby company violated the injunction up to April, 1914, with respect to damage to certain horses in the "smoke zone" and that this violation ceased when the roaster-stack baghouse was installed; but has not violated the injunction with respect to disagreeable odor maintained in the "smoke zone," nor with respect to injury produced on crops or vegetation or on domestic animals through emitting sulphur dioxide into the atmosphere; and that the company will not violate the injunction if it discharges less than 80 tons of sulphur dioxide per 24 hr. into the atmosphere, and cleans the smoke of its visible element; that the company will not violate the injunction, if for the purpose of cleaning or repairing the baghouse visible smoke is discharged for periods not to exceed a total of 48 hr. in any one month.

## Miner's Right to Recover for Injury

By A. L. H. Street*

In ore mining, miners, trammers and timbermen are engaged in one common undertaking in such sense that each is a fellow servant of the other, within the rule of law which exempts an employer from responsibility for injury to one worker caused by negligence of a fellow servant. So, a trammer who was injured through fall of ore could not recover against the mining company for which he was working, on the theory that his brother miners failed to properly examine an excavation and trim down and sound, as they should have done. (Michigan Supreme Court, Koskell vs. Newport Mining Co., 148 *Northwestern Reporter* 699.) It was further decided in the same case that the injured trammer could not recover on the theory that the defendant negligently failed to provide a reasonably safe place for work, since the legal doctrine relating to safe places of work does not apply to a place in a mine which is in the process of change, especially when the work in hand is designed to make the place safe. As an additional reason for denying plaintiff the right to recover for his injury it was held by the Michigan Supreme Court that he assumed the risk of continuing his work in face of the fact that he had observed that the place where he was injured had not been trimmed down and sounded, as was customary to his knowledge.

*Attorney, St. Paul, Minn.

## Production of Tube-Mill Pebbles in Nevada

The production of pebbles for tube-mill work is being undertaken at the Maris chalcedony quarry, near Manhattan, Nev., and 39 miles from Tonopah. The local mills have been experimenting with this rock for use in tube mills, and have found it to be satisfactory in most cases. On the soft ore of the Big Pine, the chalcedony is even more satisfactory than Danish pebbles. A test has just been completed in the mill of the West End Consolidated Mining Co., lasting six weeks. The conclusion is said to be that in comparison with Danish pebbles the Maris pebble wears as well, and in a tube mill with smooth lining the efficiency is practically the same.

The latest order for pebbles for a test run comes from the Goldfield Consolidated mill, an order for 22 tons now being filled. The shortage of pebbles from Europe, due to the war, gives an added impetus to the production from the Maris quarry and insures trials for the rock which might otherwise not have been granted to it.

Some improvement in making and sizing the pebbles is now under way. A new tube mill, 6x4 ft., with cast lining, is being built at Tonopah. This mill is to be driven by a 30-hp. gas engine. It is proposed to turn out two tons of the finished product every hour, and the pebbles will be in three sizes. Late work in the quarry has indicated that the character of the chalcedony is improving as mining progresses into the big reef. The owners of the quarry have made arrangements to place a 7-ton auto truck in commission to deliver the pebbles to the Tonopah mills.

## Chile Nitrate and the War

The disastrous effect on the nitrate industry of Chile of the war has been several times referred to, says the *Mining Journal*. According to estimates, production since the war began has been rather under 40%, without prospect of increase. Labor is greatly affected. The population of the province of Tarapacá is about 114,000, of whom, say 54,000 are in the fields, 40,000 at the ports, and 20,000 in the villages. Of these, it is estimated that 33,000 are entirely out of work; 35,000 are stated to have left the Province.

The general situation of the Province is described as appalling. Nearly all the *oficinas* are at a standstill, and general paralysis of trade is feared.

# Pulp Constants

By G. H. Clevenger*, H. W. Young† and T. N. Turner‡

*SYNOPSIS—Heretofore the specific gravity of the solution has been generally taken as unity. The degree of error arising through this source is shown, together with corrections for it and the method of applying them. The error which may be introduced through variations in temperature is discussed. Extensive tables have been calculated from which corrected values may be read for the generally used constants. Logarithms are also given for use where desired. Methods which compensate for differences in temperature are given for determining the specific gravities of dry slime, pulp and solution. Illustrative curves are shown embodying a portion of the data of the tables.*

The development of the various hydrometallurgical processes for the treatment of ores has made necessary the establishment of certain constants for calculating the various factors used in the handling of ore pulps. This need was early recognized in South Africa in connection with the cyanide process, when the first serious attempts were made to treat slime. Caldecott[1], in 1897 and 1898, published various slime-pulp formulas. At a somewhat later date tables had been calculated for special cases and were in private use at a number of mills. Lamb[2], early in 1910, published a small table showing the capacity per foot of depth for circular tanks, 12, 16, 20, 24, 28 and 30 ft. in diameter, as well as weight per cubic foot in tons, cubic feet per ton, cubic feet of pulp per ton of dry slime, and percentage of water in pulp, for a specific gravity of dry slime of 2.5 and for pulps weighing from 1012 to 1924 grams per liter. This table gives only approximate values. Sharwood[3], in 1910, published a contribution upon the subject of the measurement of pulp and tailing, in which he discussed sampling and the general formulas for the calculation of the various constants. In this article attention was called to the desirability of preparing tables to meet special cases, and several samples of such tables were given. Caldecott[4], later in 1910, published a table in which he combined slime and sand data. This table covered only the values for a specific gravity of dry slime[5] of 2.7. The values were necessarily taken at rather long intervals on account of the large range covered within the scope of one page. Hyder[6], in 1911, called attention to the serious errors which may arise when the specific gravity of the solution is assumed to be 1. He also called attention to the fact that a variation in the specific gravity of the solution produces a much greater effect than a similar variation in the specific gravity of the dry slime. Later in 1911, Stadler[7] published an account of an investigation carried on in South Africa on behalf of the Mines Trials Committee regarding the practical application of the specific-gravity flask, in which he calls attention to the accuracy of this method of determining tonnages and to its application in the control of classifiers. Early in 1912, Allen[8], in discussing the estimation of tonnage, gives several methods, and among others discusses the specific-gravity method as applied to ore pulps McLain[9], in 1912, published a straight-line diagram which showed the percentage of moisture and of solids for pulps of varying specific gravities. The specific gravity of the dry slime was assumed to be 2.65. Lowden[10], in 1912, published a table of slime-density relations, giving the number of cubic feet to make one ton (2000 lb.) of wet pulp, as well as the ratio of solids to solution, and the percentage of dry slime. This was the first table published in which values were given for more than one specific gravity of dry slime. Later, in 1912, Stevens[11] published a straight-line diagram which was an elaboration of that given by McLain. This showed percentages of solids and ratio of solution to solids for various specific gravities of wet pulp and for a specific gravity of dry slime of 2.65.

## Preparation of Detailed Tables

The range and general form of the accompanying tables were outlined in 1911, and shortly thereafter the computations were begun. Due to the large amount of work involved, which had to be done at intervals during the performance of other duties, the tables were only recently completed. Four-place logarithmic tables were employed in computing the various tables, with the exception of the table of dilutions, on account of the greater rapidity with which they could be used. The table of dilutions is intended for use in making rough comparisons, and as it is not involved in the computation of the other tables, sufficiently accurate results were obtained by the use of a slide rule. Checking the results given in the various tables by use of the proper formulas and a five- or six-place logarithmic table, or by making the calculations without the use of logarithms, may show certain of the values to be slightly in error. This is due to the fact that the last place of any logarithmic table is an approximation, hence results obtained with a four-place table may show errors in the fourth place. As the plus and minus errors in the tables are approximately evenly distributed and the total error in either direction is about the same, it is evident that if a particular table is used for calculat-

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[1]"The Solution of Gold in Accumulated and Other Slimes," Proc. Chem. and Met. Soc. S. A., Vol. 2, p. 102, p. 153; slime-pulp formulas, ibid., p. 837.

[2]"Rapid Estimation of Pulp in Cyanide Tanks," "Eng. and Min. Journ.," Vol. 89, p. 160.

[3]"Measurement of Pulp and Tailing," "Min. Mag.," Vol. 1, pp. 226-230, pp. 297-305; Vol. 2, pp. 45-53.

[4]"The Capacity of Circular Vats per Foot of Depth," "Journ." Chem., Met. and Min. Soc. S. A., Vol. 10, p. 407.

[5]The term "dry slime" does not seem to be entirely satisfactory. "Dry ore" might appear to be preferable, but here a very serious difficulty arises when part of the ore is treated as slime and part as sand. On account of general usage and the lack of a better term we have used "dry slime" throughout this article.

[6]"Specific Gravity Estimation of Pulp," Colo. Sci. Soc., Vol. 9, p. 417.,



[7]"Practical Applications of the Specific Gravity or Moisture Flask," "Journ." Chem., Met. and Min. Soc. S. A., Vol. 12, pp. 166, 171.

[8]"The Estimation of Tonnage," "Min. and Sci. Press," Vol. 104, pp. 308, 309.

[9]"Specific-Gravity Chart," "Min. and Sci. Press," Vol. 105, pp. 150, 151.

[10]"A New Slime-Density Table," "Met. and Chem. Eng.," Vol. 10, p. 369.

[11]"A Diagram for the Determination of the Solution Ratios of Slimes and Calculations Made Therefrom," "Mex. Min. Journ.," Vol. 15, pp. 24, 25.

ing the tonnage of a number of slime charges, several different values occurring in this table will be brought into use. The error introduced through this source would, therefore, be largely compensating as regards the total monthly or yearly tonnage of a slime plant. In any event, the error introduced through the use of the tables would be much less than the inherent error in the methods of ascertaining certain of the data used in applying the

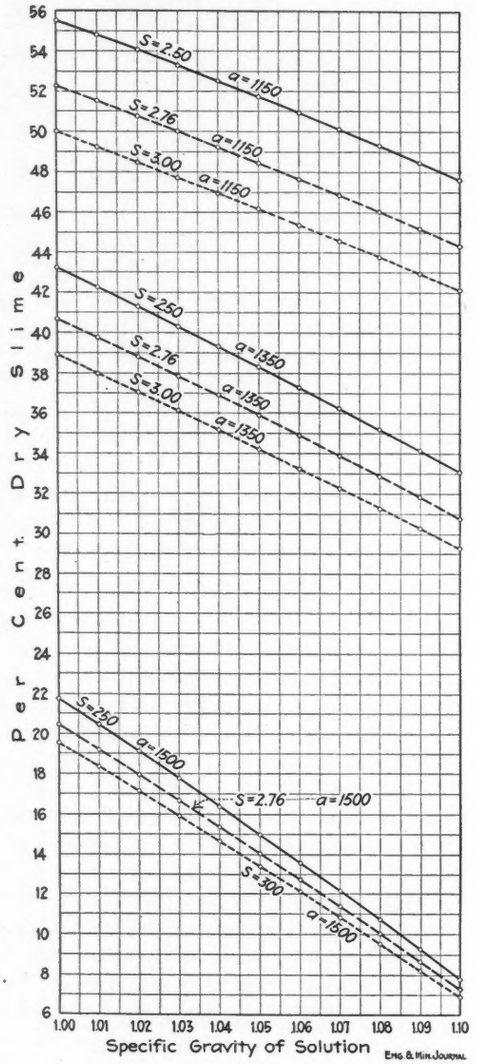



FIG. 1. EFFECT OF SPECIFIC GRAVITY OF SOLUTION ON PERCENTAGE OF DRY SLIME IN PULP

tables. With individual charges, when extreme accuracy is desired, the results can be calculated by the more accurate methods previously mentioned, but it must be borne in mind that if any benefit is to be derived through greater refinement in making the computations, the same degree of accuracy must be maintained in ascertaining the data upon which these computations are based.

The following formula[12], with the exception of Hyder's work, has generally heretofore formed the basis of the computations for the constants of slime pulps:

$$P = \frac{100\,S\,(a - 1)}{a\,(S - 1)}$$

$P$ = Percentage of dry slime in wet pulp;
$S$ = Specific gravity of dry slime;
$a$ = Specific gravity of wet pulp;
1 = Specific gravity of solution.

It will be noted that in this formula the specific gravity of the solution is taken as 1, while in reality it is always somewhat greater than 1. Mr. Turner has investigated the specific gravity of a number of cyanide-mill solutions. Some of the results are given in the accompanying table:

SPECIFIC GRAVITY OF WORKING CYANIDE SOLUTIONS

| Solution | | Specific Gravity |
|---|---|---|
| Fresh solution | ..... | 1.00170 |
| Butters plant, Virginia City, Nev | Heads | 1.00281 |
| Butters plant, Virginia City, Nev | Tails | 1.00279 |
| Belmont plant, Tonopah, Nev | Heads | 1.00881 |
| Belmont plant, Tonopah, Nev | Tails | 1.00873 |
| Montana-Tonopah, Tonopah, Nev | Heads | 1.00314 |
| Empire, Grass Valley, Calif | Heads | 1.00142 |
| [13]Portland, Colorado Springs, Colo | Heads | 1.01000 |
| [14]South Africa, average | ..... | 1.00210 |
| Pittsburgh-Silver Peak, Blair, Nev | Heads | 1.00309 |

We have derived the above formula, assigning a general

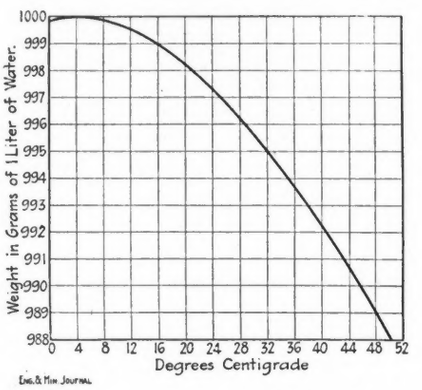



FIG. 2. WATER WEIGHT AND TEMPERATURE

value $d$ for the specific gravity of the solution. The principal steps in the derivation are given below.

Let
$a$ = Specific gravity of wet pulp;
$S$ = Specific gravity of dry slime;
$V$ = Total volume of wet pulp;
$m$ = Total weight of dry slime in wet pulp;
$c$ = Volume of solution in wet pulp;
$d$ = Specific gravity of solution;
$P$ = Percentage of dry slime in wet pulp;

$$a = \frac{m + cd}{V} \qquad S = \frac{m}{(V - c)}$$

Solving for $c$, equating values, simplifying and solving for $m$:

$$m = \frac{SV\,(a - d)}{(S - d)}$$

$P$ is obtained by multiplying the above value of $m$ by 100 and dividing by the weight of the wet pulp, $Va$:

$$P = \frac{100\,S\,(a - d)}{a\,(S - d)}$$

It has been generally supposed that the differenee be-

[12]"The Cyanide Handbook," J. E. Clennell, New York, 1910, pp. 479-480.

[13]Determination by J. M. Tippett. Personal communication.

[14]Determination by M. T. Murray, "Practical Applications of the Specific Gravity or Moisture Flask." "Journ." Chem., Met. and Min. Soc. of S. A., Vol. 12. p. 170.

tween the specific gravity of the average mill solution and that of water was so slight that the error introduced through this source would be negligible. The results previously given for the specific gravity of mill solutions indicate that there is considerable variation. This variation in many cases bears no fixed relationship to the cyanide strength and alkalinity of the solution. The specific gravity is governed to no small extent by other salts which accumulate in solution and in certain cases to foreign salts which are added to perform special functions. Hyder's[15] article is a notable exception to this, as he derives the formula taking a general value for the specific gravity of the solutions, and calls particular attention to the error introduced when the specific gravity of the solution is assumed to be 1. Unfortunately most operators do not appear to be familiar with his work. Stadler[16] states that the specific gravity of South African

TABLE A. SHOWING THE EFFECT OF THE SPECIFIC GRAVITY OF THE SOLUTION UPON THE PERCENTAGE OF DRY SLIME IN WET PULP

| Sp. G. of Solution | Sp. G. of Dry Slime = 2.50 | | | | | | Sp. G. of Dry Slime = 2.76 | | | | | | Sp. G. of Dry Slime = 3.00 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weight of 1 liter of Pulp | | | | | | Weight of 1 liter of Pulp | | | | | | Weight of 1 liter of Pulp | | | | | |
| | 1150 | | 1350 | | 1500 | | 1150 | | 1350 | | 1500 | | 1150 | | 1350 | | 1500 | |
| | P | P′ | P | P′ | P | P′ | P | P′ | P | P′ | P | P′ | P | P′ | P | P′ | P | P′ |
| 1.000 | 21.739 | 21.739 | 43.211 | 43.211 | 55.555 | 55.555 | 20.455 | 20.455 | 40.657 | 40.657 | 52.273 | 52.273 | 19.565 | 19.565 | 38.889 | 38.889 | 50.001 | 50.001 |
| 1.010 | 20.426 | 20.426 | 42.257 | 42.257 | 54.810 | 54.810 | 19.200 | 19.200 | 39.721 | 39.721 | 51.520 | 51.520 | 18.353 | 18.353 | 37.968 | 37.968 | 49.246 | 49.246 |
| 1.020 | 19.095 | 19.113 | 41.292 | 41.303 | 54.054 | 54.065 | 17.931 | 17.945 | 38.774 | 38.785 | 50.759 | 50.769 | 17.127 | 17.141 | 37.037 | 37.047 | 48.484 | 48.491 |
| 1.030 | 17.746 | 17.800 | 40.313 | 40.349 | 53.288 | 53.320 | 16.647 | 16.690 | 37.817 | 37.849 | 49.989 | 50.017 | 15.890 | 15.929 | 36.097 | 36.126 | 47.715 | 47.736 |
| 1.040 | 16.379 | 15.487 | 39.321 | 39.395 | 52.512 | 52.575 | 15.349 | 15.435 | 36.847 | 36.913 | 49.210 | 49.265 | 14.640 | 14.717 | 35.147 | 35.205 | 46.939 | 46.981 |
| 1.050 | 14.992 | 14.174 | 38.314 | 38.441 | 51.724 | 51.830 | 14.035 | 14.180 | 35.867 | 35.977 | 48.421 | 48.523 | 13.378 | 13.505 | 34.188 | 34.284 | 46.154 | 46.226 |
| 1.060 | 13.587 | 13.861 | 37.295 | 37.487 | 50.925 | 51.085 | 12.706 | 12.925 | 34.876 | 35.041 | 47.623 | 47.761 | 12.102 | 12.293 | 33.218 | 33.363 | 45.361 | 45.471 |
| 1.070 | 12.162 | 12.548 | 36.260 | 36.533 | 50.116 | 50.340 | 11.361 | 11.670 | 33.872 | 34.105 | 46.816 | 46.999 | 10.813 | 11.081 | 32.239 | 32.442 | 44.559 | 44.716 |
| 1.080 | 10.716 | 11.235 | 35.211 | 35.579 | 49.295 | 49.595 | 10.000 | 10.415 | 32.857 | 33.169 | 46.000 | 46.257 | 9.511 | 9.869 | 31.250 | 31.521 | 43.750 | 43.961 |
| 1.090 | 9.251 | 9.922 | 34.148 | 34.625 | 48.463 | 48.850 | 8.622 | 8.170 | 31.829 | 32.233 | 45.173 | 45.505 | 8.195 | 8.657 | 30.250 | 30.600 | 42.932 | 43.206 |
| 1.100 | 7.764 | 8.609 | 33.069 | 33.671 | 47.619 | 48.105 | 7.229 | 7.905 | 30.790 | 31.297 | 44.337 | 44.753 | 6.865 | 7.445 | 29.240 | 29.679 | 42.106 | 42.451 |

solution is not high enough to cause an important error in estimating the tonnage of dry slime. Sharwood[17] has called attention to the fact that with excessively thin mixtures, such as the overflow of dams or clarifying tanks, the dissolved salts in the water may have an important influence upon the determination of the solids in suspension.

### Variation Due to Specific Gravity of Solution

In order to show the importance of making a correction for the specific gravity of the solution, we give two cases which could readily occur in cyanide practice.

Taking the specific gravity of the dry slime as 2.66 and the weight of one liter of the wet pulp equal to 1260 grams (specific gravity 1.260).

(a) Taking the specific gravity of the solution at 1.000, $P = 33.07\%$.

(b) Taking the specific gravity of the solution as 1.008, $P = 32.20\%$.

The percentage of difference would be 2.63.

Again, taking the specific gravity of the dry slime as 2.66 and the weight of one liter of the wet pulp equal to 1100 grams (specific gravity 1.100).

(a) Taking the specific gravity of the solution as 1.000, $P = 14.56\%$.

(b) Taking the specific gravity of the solution as 1.008, $P = 13.47\%$.

The percentage of difference in this case would be 7.49.

It will be noted that as the percentage of solids in the pulp decreases the percentage of error from this source increases.

In the hydrometallurgy of copper, which is now of rapidly increasing importance, solutions having a comparatively high specific gravity are frequently used. In order to show more fully the effect of the specific gravity of the solution upon the percentage of dry slime in wet pulps, and particularly for pulps in which the specific gravity of the solution is higher than that met with in cyanide practice, we have calculated the values given under $P$ and $P'$ in Table $A$.

The values given under $P$ have been calculated by substituting in the formula and solving by the use of a five-place logarithmic table.

The values given under $P'$ have been calculated by taking the value for $P$ when $d$ is 1 and deducting from it a correction arrived at by taking as a constant, the difference between the value for $P$ when $d$ is 1 and when $d$ is 1.010, and multiplying by the number of hundredths, taken as a whole number, by which $d$ is greater than 1. Comparison of the values given for $P$ and $P'$ in Table $A$, as well as the curves given for both values in Fig. 1, will show the degree of error which would be introduced at various parts of the table by the use of this constant for values of $d$ above 1.

It will be noted that the percentages given under $P$ as the specific gravity of the solution increases do not form a straight line; therefore a constant cannot be given for applying this correction which is accurate throughout the whole range shown by the curves. But we have found that covering the range of the present tables, which have been more particularly calculated for use with the cyanide process, i.e., for values of $d$ up to 1.010, this portion of the curve is so nearly a straight line that to show any curvature of the line between these two points it is necessary to make the computations by considerably more refined methods than those used in calculating the values given in the tables to which this correction is applied; therefore, to keep the tables within reasonable bounds, we have given a constant for each value which has been calculated by assuming that between these limits the percentage line is straight. In each case the value of $P$ has been calculated, taking $d$ as 1 and also as 1.010. The difference between these two results, divided by 10, gives the constant used. The method of applying this correction is explained more in detail in connection with each table.

### Effect of Temperature

Variations in temperature cause a change in volume of wet pulps which may give rise to a more or less serious error, the magnitude of which depends upon the tempera-

[15] "Specific Gravity Estimation of Pulp," Colo. Sci. Soc., Vol. 9, p. 417.

[16] "Practical Applications of the Specific Gravity or Moisture Flask," "Journ." Chem., Met. and Min. Soc. S. A., Vol. 12, p. 170.

[17] "Measurement of Pulp and Tailing," "Min. Mag.," Vol. 1, p. 298.

ture difference. In former articles upon the subject, the effect of temperature has been ignored. The range in temperature of pulps in cyanide practice may vary from slightly above freezing, in a cold climate, to about 50° C. (122° F.), in a tropical country, or where the solutions are heated. To illustrate the effect of temperature, we have plotted the accompanying curve which will show the decrease in the density of water[18] with increasing temperature, (p. 1080).

After considerable investigation, we have concluded that the best method of providing for this correction is to make all calculations upon the basis of water at its greatest density (4° C.). If the specific gravity of the dry slime is determined using distilled water at 4° C. and the precaution is taken of weighing the liter of pulp at the same temperature, whatever that may be, of the large mass of pulp in the tank, in a liter flask which has been calibrated at 4° C., the effect of temperature is provided for with the exception of that due to the expansion of the flask and of the tank containing the pulp, with increasing temperature above 4° C. An ordinary glass flask[19] calibrated to contain 100 grams of water at 4° C. (39.2° F.), if used with pulps at 50° C. (122° F.) would expand about ⅛%. With average pulps this would amount to about 1½ grams per liter. The expansion of wooden tanks with increasing temperature is variable, depending upon the variety of wood[20] of which the tanks are constructed, as well as the limitation imposed by the steel hoops. The circumference of a steel tank[21] 50 ft. in diameter would be increased by about 1 in. by a rise of temperature from 4°C. to 50° C. The error due to the expansion of the liter flask is, therefore, largely compensated by the expansion of the tank containing the pulp; but even if this were not the case, this correction would be negligible.

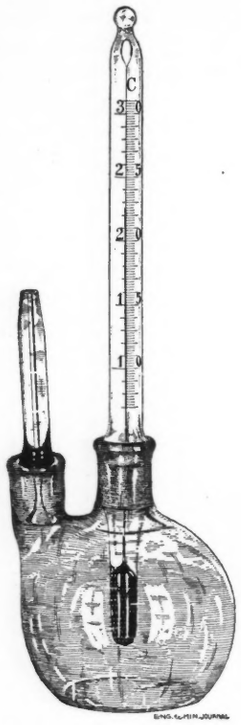


FIG. 3. PYCNOMETER

### DETERMINATION OF THE SPECIFIC GRAVITY OF THE DRY SLIME

*S* (specific gravity of the dry slime) may be determined upon a sample of the dry slime by the well known pycnometer method. The pycnometer most generally used for this purpose is a small glass bottle, as shown in Fig. 3, having two necks. Into the central neck is introduced a small glass thermometer, through the medium of a ground joint, for the purpose of indicating the temperature. Similarly, into the other neck is fitted a glass stopper, having a capillary opening at the center.

Clean the pycnometer and fill with recently boiled distilled water at 4° C. so that the water just overflows the capillary opening in the glass stopper. Dry the outside and weigh accurately. Call this weight "D." Fill the pycnometer about half full of distilled water, then introduce five grams of the dry slime, which has been accurately weighed. Boil to remove air, cool on ice to 4° C., add water at 4° C. to fill the flask, and weigh. Call this weight *C*. Call the weight of the ore taken *W*. Specific gravity of the dry slime $= \frac{W}{D + W - C}$. By taking a greater weight of the dry slime, this determination can be made in the ordinary 1000-c.c. flask, and it is perhaps desirable to use the larger flask when an accurate analytical balance is not available.

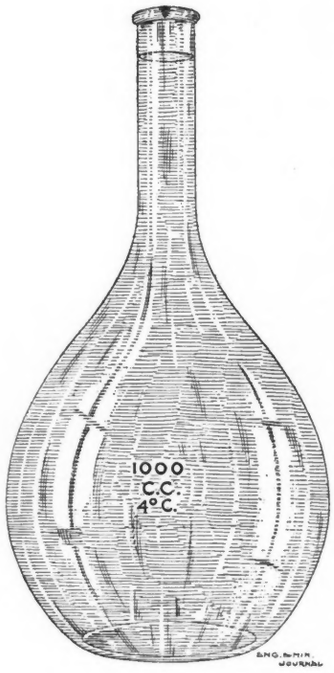



FIG. 4. 1000-C.C. FLASK FOR WEIGHING PULP

This is sometimes termed the specific gravity of the wet pulp, but the weight of a liter of the wet pulp, expressed in grams, appears to be a better term, therefore we have designated it in this manner throughout the tables. This is determined by weighing 1000 c.c. of the wet pulp at the temperature of the large mass of pulp. Sharwood[22] prefers a conical vessel made of tin plate for making this determination in mill work. Stadler[23] states that in practice he has found that a flask (presumably glass) having a large mouth ground true, the ground edge to be used as a mark of capacity, is more convenient than the usual flask with a mark below the mouth. Pooler[24] admits the convenience of the large neck flask as advocated by Stadler, but calls attention to the great error which may arise when it is used. For various reasons we favor for this purpose in both laboratory and mill work the use of the ordinary 1000-c.c. narrow-neck flask cut off about ½ in. above the mark, as shown in Fig. 4. The narrow neck projecting a short distance above the mark makes for greater accuracy and on account of the care necessary in handling a flask completely filled with solution or pulp is fully as convenient to use as the wide-neck flask which is filled level full. The frequent breaking of the glass flask, due to the rough handling which such apparatus receives in mill work, cannot be denied; but herein lies one of its strong points of advantage. A thin metal flask may soon become inaccurate through distortion and denting; but as long as it does not leak, the mill man is prone to con-

[18] Calculated from data given in "Physical and Chemical Constants," by Kaye and Saby, p. 22.
[19] Ibid., p. 53.
[20] Ibid., p. 53.
[21] Ibid., p. 53.
[22] "Measurement of Pulp and Tailing," "Min. Mag.," Vol. 1, p. 304.
[23] "Practical Applications of the Specific Gravity or Moisture Flask," "Journ." Chem., Met. and Min. Soc. S. A., Vol. 12, p. 167.
[24] "Discussion of Practical Application of the Specific Gravity or Moisture Flask," "Journ." Chem., Met. and Min. Soc. S. A., Vol. 12, p. 170.

tinue its use. When such an accident happens to a glass flask, it is put entirely out of service. Another source of error in both glass and metal flasks is the coating of lime and slime which tends to build up upon the inside of the flask. A glass flask can be readily cleaned with acid, while a metal flask is not so readily cleaned.

The ordinary 1000-c.c. flask, as received from the dealer, should be calibrated by weighing in it exactly 1000 grams of distilled water at 4° C. Mark the level of the bottom of the meniscus by means of a file on the neck of the flask, and as has been previously mentioned, it is an advantage to cut off the neck about ½ in. above the mark. The flask should always be thoroughly cleaned before being used.

Care must be taken in obtaining the sample of pulp for this determination to insure that it is truly representative of the whole mass in the tank. The sample is perhaps best taken as suggested by Caldecott[25] by using a vessel having a small opening, so that the pulp can be taken at different depths in the tank. The pulp should be in violent agitation when the sample is taken. Thoroughly mix the pulp by stirring before filling the flask. After wiping out the inside of the neck of the flask above the pulp with a clean rag or piece of filter paper, weigh in grams upon a large pulp balance and deduct the weight of the flask. Example: If the net weight of 1000 c.c. of the pulp is 1235.6 grams, the specific gravity is 1.2356.

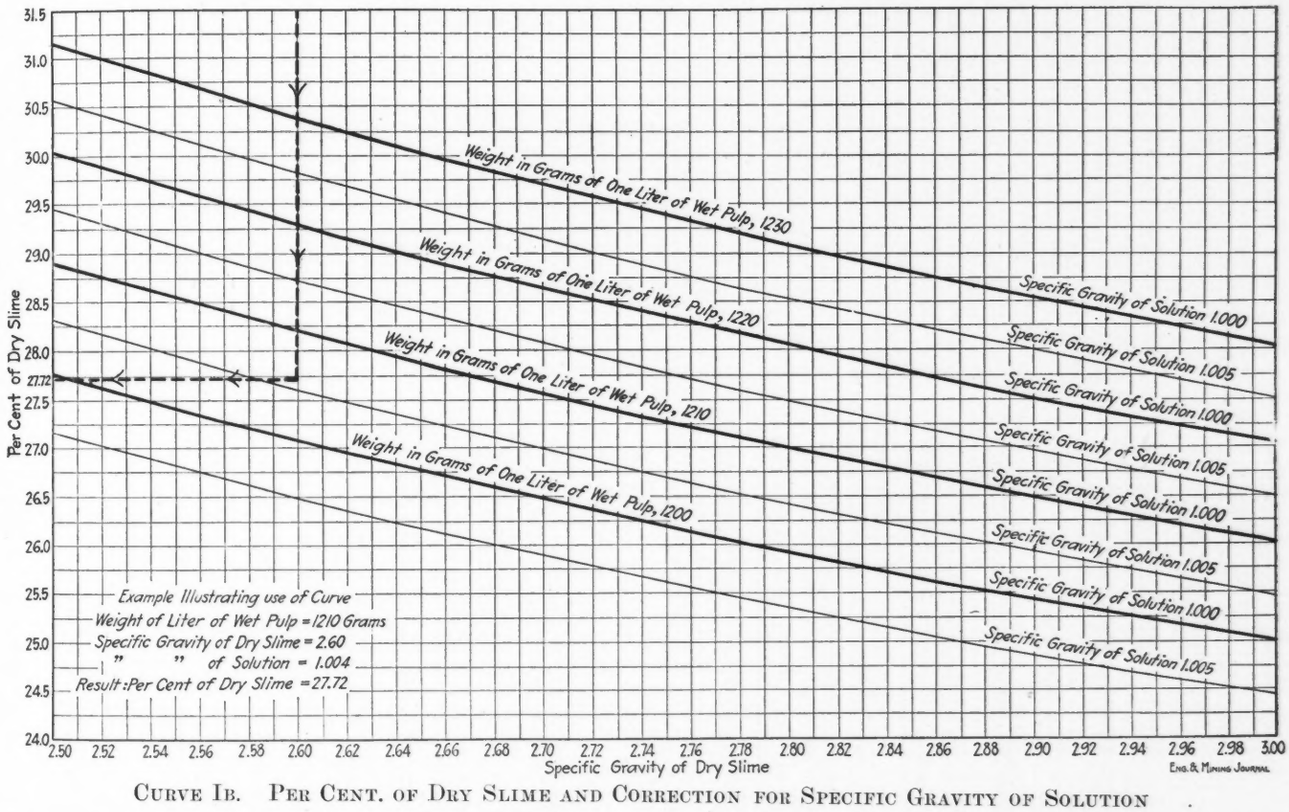
The weight of a liter of pulp expressed in grams is used in connection with the various tables; but if this value is substituted in formulas in which the specific gravity of the dry slime and of the solution appear, it must be expressed as specific gravity.

The hydrometer does not ordinarily give satisfactory results when used for determining the specific gravity of slime pulp, but there is a special type which we have not had the opportunity of investigating, which, with certain modifications, appears to be capable of giving good results.

Fill the 1000-c.c. flask (calibrated at 4° C.) with clear solution which has been cooled to 4°. Weigh the flask in grams and point off three places to give specific gravity. Example: If the net weight of the solution is 1008 grams, the specific gravity is 1.008.

### Accuracy of Specific-Gravity Method of Determining Tonnage

The accuracy of the specific-gravity method of determining tonnage when used over a sufficiently long period of time seems to be pretty well established. Slight errors in the determinations and calculations are largely compensating when a large number of slime charges are involved, for they do not occur in the same direction. However, there are other errors which apparently are unimportant because of the slight effect upon individual charges which become of importance when a large number of charges are involved, on account of occurring in one direction; thus disregard of the specific gravity of the solution might in certain cases cause an important effect upon a year's tonnage. Stadler[26] states that at the Knight Gold Mining Co.'s cyanide plant the daily tonnage measurements of the mill pulp for several years have been regularly taken by the specific-gravity method, which after careful investigation was found to give most reliable results. Johnston[27] states that the tonnage treated at the Nipissing low-grade mill, as determined




Curve Ib. Per Cent. of Dry Slime and Correction for Specific Gravity of Solution

[25] "Slime Pulp Formulas," W. A. Caldecott. Proc. Chem. and Met. Soc. S. A., Vol. 2, p. 837.

[26] "Practical Applications of the Specific Gravity or Moisture Flask," "Journ." Chem., Met. and Min. Soc. S. A., Vol. 12, p. 168.

[27] "The Mill and Metallurgical Practice of the Nipissing Mining Co., Ltd., Cobalt, Ont., Canada," Bull. A. I. M. E., Jan., 1914, p. 122.

TABLE 1. PER CENT. OF DRY SLIME AND CORRECTION FOR SPECIFIC GRAVITY OF SOLUTION

Formula: $P = \frac{100\,S\,(a-d)}{a\,(S-d)}$

Specific Gravity of Dry Slime

Weight in Grams of One Liter of Wet Pulp

| | 2.50 | Correction | 2.52 | Correction | 2.54 | Correction | 2.56 | Correction | 2.58 | Correction | 2.60 | Correction | 2.62 | Correction | 2.64 | Correction | 2.66 | Correction | 2.68 | Correction | 2.70 | Correction | 2.72 | Correction | 2.74 | Correction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | 1.650 | .1650 | 1.642 | .1642 | 1.633 | .1633 | 1.625 | .1625 | 1.617 | .1617 | 1.609 | .1609 | 1.601 | .1601 | 1.594 | .1594 | 1.586 | .1586 | 1.579 | .1579 | 1.573 | .1573 | 1.566 | .1566 | 1.560 | .1560 |
| 1020 | 3.268 | .1623 | 3.251 | .1615 | 3.234 | .1607 | 3.217 | .1598 | 3.201 | .1590 | 3.186 | .1583 | 3.171 | .1575 | 3.156 | .1568 | 3.142 | .1561 | 3.128 | .1555 | 3.115 | .1548 | 3.101 | .1541 | 3.088 | .1535 |
| 1030 | 4.854 | .1597 | 4.829 | .1589 | 4.804 | .1581 | 4.780 | .1573 | 4.756 | .1565 | 4.733 | .1558 | 4.711 | .1551 | 4.689 | .1544 | 4.668 | .1537 | 4.647 | .1531 | 4.627 | .1525 | 4.607 | .1518 | 4.588 | .1512 |
| 1040 | 6.411 | .1571 | 6.378 | .1564 | 6.345 | .1556 | 6.312 | .1548 | 6.281 | .1541 | 6.252 | .1534 | 6.222 | .1527 | 6.192 | .1520 | 6.163 | .1513 | 6.136 | .1507 | 6.110 | .1501 | 6.084 | .1495 | 6.059 | .1489 |
| 1050 | 7.936 | .1545 | 7.895 | .1537 | 7.854 | .1530 | 7.814 | .1523 | 7.776 | .1516 | 7.739 | .1509 | 7.702 | .1502 | 7.666 | .1496 | 7.631 | .1490 | 7.597 | .1484 | 7.565 | .1478 | 7.532 | .1472 | 7.501 | .1466 |
| 1060 | 9.435 | .1521 | 9.386 | .1514 | 9.337 | .1506 | 9.290 | .1499 | 9.244 | .1492 | 9.200 | .1486 | 9.156 | .1479 | 9.114 | .1473 | 9.072 | .1467 | 9.031 | .1461 | 8.992 | .1455 | 8.954 | .1449 | 8.916 | .1443 |
| 1070 | 10.90 | .149 | 10.85 | .149 | 10.79 | .148 | 10.73 | .147 | 10.68 | .146 | 10.63 | .146 | 10.58 | .145 | 10.53 | .145 | 10.48 | .144 | 10.44 | .144 | 10.39 | .143 | 10.35 | .143 | 10.30 | .142 |
| 1080 | 12.34 | .147 | 12.28 | .146 | 12.22 | .146 | 12.16 | .145 | 12.10 | .145 | 12.04 | .144 | 11.98 | .143 | 11.92 | .142 | 11.87 | .142 | 11.82 | .142 | 11.77 | .141 | 11.72 | .141 | 11.67 | .140 |
| 1090 | 13.76 | .145 | 13.69 | .144 | 13.62 | .144 | 13.55 | .143 | 13.48 | .142 | 13.42 | .142 | 13.35 | .140 | 13.29 | .140 | 13.23 | .140 | 13.17 | .139 | 13.12 | .139 | 13.06 | .139 | 13.01 | .138 |
| 1100 | 15.15 | .143 | 15.07 | .142 | 14.99 | .141 | 14.91 | .140 | 14.84 | .140 | 14.77 | .139 | 14.70 | .139 | 14.63 | .138 | 14.56 | .137 | 14.50 | .137 | 14.44 | .137 | 14.38 | .137 | 14.32 | .136 |
| 1110 | 16.52 | .140 | 16.43 | .139 | 16.34 | .138 | 16.26 | .138 | 16.18 | .138 | 16.11 | .138 | 16.03 | .137 | 15.95 | .136 | 15.88 | .136 | 15.81 | .135 | 15.74 | .135 | 15.67 | .134 | 15.61 | .134 |
| 1120 | 17.86 | .138 | 17.76 | .137 | 17.67 | .136 | 17.58 | .136 | 17.50 | .136 | 17.41 | .135 | 17.33 | .135 | 17.25 | .134 | 17.17 | .134 | 17.09 | .133 | 17.02 | .133 | 16.95 | .133 | 16.88 | .132 |
| 1130 | 19.17 | .136 | 19.07 | .135 | 18.97 | .134 | 18.87 | .133 | 18.78 | .133 | 18.69 | .132 | 18.60 | .132 | 18.52 | .132 | 18.43 | .131 | 18.35 | .131 | 18.27 | .130 | 18.19 | .130 | 18.12 | .130 |
| 1140 | 20.47 | .134 | 20.36 | .133 | 20.25 | .132 | 20.15 | .132 | 20.05 | .131 | 19.95 | .130 | 19.86 | .130 | 19.77 | .130 | 19.68 | .130 | 19.59 | .129 | 19.51 | .129 | 19.42 | .128 | 19.34 | .128 |
| 1150 | 21.74 | .132 | 21.62 | .131 | 21.51 | .130 | 21.40 | .130 | 21.30 | .130 | 21.20 | .129 | 21.10 | .128 | 21.00 | .129 | 20.90 | .128 | 20.81 | .128 | 20.72 | .127 | 20.63 | .127 | 20.54 | .126 |
| 1160 | 22.99 | .130 | 22.87 | .129 | 22.75 | .129 | 22.63 | .128 | 22.52 | .127 | 22.41 | .127 | 22.30 | .126 | 22.20 | .126 | 22.10 | .126 | 22.00 | .125 | 21.91 | .125 | 21.81 | .124 | 21.72 | .124 |
| 1170 | 24.21 | .127 | 24.08 | .127 | 23.96 | .126 | 23.84 | .126 | 23.72 | .125 | 23.61 | .125 | 23.50 | .125 | 23.39 | .124 | 23.28 | .124 | 23.18 | .124 | 23.08 | .123 | 22.98 | .123 | 22.88 | .122 |
| 1180 | 25.42 | .125 | 25.29 | .125 | 25.16 | .125 | 25.03 | .124 | 24.91 | .124 | 24.79 | .123 | 24.67 | .123 | 24.56 | .123 | 24.45 | .123 | 24.34 | .122 | 24.23 | .122 | 24.12 | .121 | 24.02 | .120 |
| 1190 | 26.61 | .123 | 26.47 | .123 | 26.34 | .123 | 26.21 | .122 | 26.08 | .122 | 25.95 | .121 | 25.83 | .121 | 25.71 | .121 | 25.59 | .120 | 25.48 | .120 | 25.37 | .120 | 25.26 | .119 | 25.15 | .118 |
| 1200 | 27.77 | .121 | 27.63 | .121 | 27.49 | .121 | 27.35 | .120 | 27.21 | .119 | 27.08 | .119 | 26.95 | .118 | 26.83 | .118 | 26.71 | .118 | 26.59 | .118 | 26.47 | .117 | 26.36 | .117 | 26.25 | .117 |
| 1210 | 28.92 | .119 | 28.77 | .119 | 28.62 | .119 | 28.48 | .118 | 28.34 | .118 | 28.20 | .117 | 28.07 | .117 | 27.94 | .117 | 27.81 | .117 | 27.69 | .116 | 27.57 | .116 | 27.45 | .116 | 27.33 | .115 |
| 1220 | 30.05 | .118 | 29.89 | .117 | 29.74 | .117 | 29.59 | .116 | 29.44 | .116 | 29.30 | .116 | 29.16 | .115 | 29.03 | .115 | 28.89 | .114 | 28.76 | .114 | 28.64 | .114 | 28.52 | .114 | 28.40 | .114 |
| 1230 | 31.16 | .115 | 31.00 | .115 | 30.84 | .115 | 30.68 | .114 | 30.53 | .114 | 30.39 | .114 | 30.24 | .113 | 30.10 | .113 | 29.96 | .113 | 29.83 | .113 | 29.70 | .112 | 29.57 | .112 | 29.44 | .112 |
| 1240 | 32.26 | .114 | 32.09 | .114 | 31.92 | .113 | 31.76 | .113 | 31.60 | .112 | 31.45 | .112 | 31.30 | .112 | 31.16 | .112 | 31.02 | .112 | 30.88 | .112 | 30.75 | .111 | 30.62 | .111 | 30.49 | .111 |
| 1250 | 33.33 | .112 | 33.16 | .112 | 32.99 | .112 | 32.82 | .111 | 32.66 | .111 | 32.50 | .110 | 32.35 | .110 | 32.20 | .110 | 32.05 | .110 | 31.90 | .110 | 31.76 | .109 | 31.63 | .109 | 31.50 | .109 |
| 1260 | 34.39 | .111 | 34.21 | .110 | 34.02 | .110 | 33.86 | .110 | 33.69 | .109 | 33.53 | .109 | 33.37 | .109 | 33.22 | .109 | 33.07 | .109 | 32.92 | .108 | 32.78 | .108 | 32.64 | .108 | 32.50 | .108 |
| 1270 | 35.43 | .109 | 35.25 | .108 | 35.07 | .108 | 34.89 | .108 | 34.72 | .108 | 34.55 | .108 | 34.39 | .107 | 34.23 | .107 | 34.07 | .106 | 33.92 | .106 | 33.77 | .106 | 33.62 | .106 | 33.48 | .105 |
| 1280 | 36.46 | .107 | 36.27 | .107 | 36.08 | .106 | 35.90 | .106 | 35.72 | .106 | 35.55 | .106 | 35.38 | .105 | 35.22 | .105 | 35.06 | .105 | 34.90 | .105 | 34.75 | .105 | 34.60 | .104 | 34.45 | .104 |
| 1290 | 37.46 | .105 | 37.27 | .104 | 37.08 | .104 | 36.89 | .104 | 36.71 | .104 | 36.53 | .104 | 36.36 | .103 | 36.19 | .103 | 36.02 | .103 | 35.86 | .103 | 35.71 | .103 | 35.56 | .102 | 35.41 | .102 |
| 1300 | 38.46 | .103 | 38.26 | .103 | 38.06 | .102 | 37.87 | .102 | 37.68 | .102 | 37.50 | .102 | 37.32 | .102 | 37.15 | .102 | 36.98 | .102 | 36.82 | .102 | 36.66 | .102 | 36.50 | .101 | 36.34 | .101 |
| 1310 | 39.44 | .102 | 39.23 | .102 | 39.03 | .101 | 38.83 | .101 | 38.64 | .101 | 38.45 | .101 | 38.27 | .101 | 38.09 | .101 | 37.92 | .100 | 37.75 | .100 | 37.59 | .100 | 37.43 | .100 | 37.27 | .100 |
| 1320 | 40.40 | .100 | 40.19 | .100 | 39.98 | .099 | 39.78 | .099 | 39.58 | .099 | 39.39 | .099 | 39.20 | .099 | 39.02 | .099 | 38.84 | .098 | 38.67 | .098 | 38.50 | .098 | 38.33 | .097 | 38.17 | .097 |
| 1330 | 41.34 | .098 | 41.13 | .098 | 40.92 | .098 | 40.71 | .098 | 40.51 | .098 | 40.32 | .098 | 40.13 | .098 | 39.94 | .098 | 39.75 | .097 | 39.57 | .097 | 39.40 | .097 | 39.23 | .096 | 39.07 | .096 |
| 1340 | 42.29 | .096 | 42.07 | .097 | 41.85 | .097 | 41.64 | .097 | 41.43 | .097 | 41.23 | .096 | 41.04 | .096 | 40.85 | .096 | 40.66 | .096 | 40.48 | .096 | 40.30 | .096 | 40.13 | .095 | 39.96 | .095 |
| 1350 | 43.21 | .095 | 42.99 | .095 | 42.77 | .095 | 42.55 | .095 | 42.34 | .095 | 42.14 | .095 | 41.94 | .095 | 41.74 | .095 | 41.55 | .095 | 41.37 | .095 | 41.19 | .095 | 41.01 | .094 | 40.84 | .094 |
| 1360 | 44.12 | .094 | 43.89 | .094 | 43.66 | .093 | 43.44 | .093 | 43.23 | .093 | 43.02 | .093 | 42.82 | .093 | 42.62 | .093 | 42.42 | .093 | 42.23 | .093 | 42.05 | .093 | 41.87 | .092 | 41.69 | .092 |
| 1370 | 45.01 | .092 | 44.78 | .092 | 44.55 | .092 | 44.32 | .092 | 44.10 | .092 | 43.89 | .092 | 43.68 | .092 | 43.48 | .092 | 43.28 | .092 | 43.09 | .092 | 42.90 | .092 | 42.72 | .091 | 42.54 | .091 |
| 1380 | 45.89 | .091 | 45.65 | .091 | 45.41 | .091 | 45.18 | .091 | 44.96 | .091 | 44.75 | .091 | 44.54 | .091 | 44.33 | .091 | 44.13 | .091 | 43.93 | .091 | 43.74 | .091 | 43.55 | .090 | 43.37 | .090 |
| 1390 | 46.76 | .089 | 46.52 | .089 | 46.28 | .089 | 46.05 | .089 | 45.82 | .089 | 45.60 | .089 | 45.38 | .089 | 45.17 | .089 | 44.97 | .089 | 44.77 | .089 | 44.58 | .089 | 44.39 | .089 | 44.20 | .089 |
| 1400 | 47.63 | .088 | 47.38 | .088 | 47.13 | .088 | 46.89 | .088 | 46.66 | .088 | 46.44 | .088 | 46.22 | .088 | 46.00 | .088 | 45.79 | .088 | 45.59 | .088 | 45.39 | .088 | 45.20 | .087 | 45.01 | .087 |
| 1410 | 48.46 | .086 | 48.21 | .086 | 47.96 | .086 | 47.72 | .086 | 47.49 | .086 | 47.26 | .086 | 47.04 | .086 | 46.82 | .086 | 46.60 | .086 | 46.39 | .086 | 46.19 | .086 | 45.99 | .086 | 45.80 | .086 |
| 1420 | 49.28 | .084 | 49.03 | .084 | 48.78 | .084 | 48.53 | .084 | 48.29 | .084 | 48.06 | .084 | 47.83 | .084 | 47.61 | .084 | 47.39 | .084 | 47.18 | .084 | 46.98 | .084 | 46.78 | .084 | 46.58 | .084 |
| 1430 | 50.12 | .083 | 49.86 | .083 | 49.60 | .083 | 49.35 | .083 | 49.11 | .083 | 48.87 | .083 | 48.64 | .083 | 48.41 | .083 | 48.19 | .083 | 47.97 | .083 | 47.76 | .083 | 47.56 | .083 | 47.36 | .083 |
| 1440 | 50.92 | .082 | 50.66 | .082 | 50.40 | .082 | 50.14 | .082 | 49.89 | .082 | 49.65 | .082 | 49.42 | .082 | 49.19 | .082 | 48.96 | .082 | 48.74 | .082 | 48.53 | .082 | 48.32 | .082 | 48.12 | .082 |
| 1450 | 51.72 | .080 | 51.45 | .080 | 51.18 | .080 | 50.92 | .080 | 50.67 | .080 | 50.43 | .080 | 50.19 | .080 | 49.96 | .080 | 49.73 | .080 | 49.51 | .080 | 49.29 | .080 | 49.08 | .080 | 48.87 | .080 |
| 1460 | 52.50 | .079 | 52.23 | .079 | 51.96 | .079 | 51.70 | .079 | 51.45 | .079 | 51.20 | .079 | 50.96 | .079 | 50.72 | .079 | 50.49 | .079 | 50.26 | .079 | 50.04 | .079 | 49.83 | .079 | 49.62 | .079 |
| 1470 | 53.29 | .078 | 53.01 | .078 | 52.74 | .078 | 52.47 | .078 | 52.21 | .078 | 51.96 | .078 | 51.71 | .078 | 51.47 | .078 | 51.24 | .078 | 51.01 | .078 | 50.79 | .078 | 50.57 | .078 | 50.36 | .078 |
| 1480 | 54.05 | .077 | 53.76 | .077 | 53.48 | .077 | 53.21 | .077 | 52.95 | .077 | 52.69 | .077 | 52.44 | .077 | 52.20 | .077 | 51.96 | .077 | 51.73 | .077 | 51.51 | .077 | 51.29 | .077 | 51.07 | .077 |
| 1490 | 54.81 | .076 | 54.52 | .076 | 54.24 | .076 | 53.97 | .076 | 53.70 | .076 | 53.44 | .076 | 53.19 | .076 | 52.94 | .076 | 52.70 | .076 | 52.46 | .076 | 52.23 | .076 | 52.01 | .076 | 51.79 | .076 |
| 1500 | 55.56 | .075 | 55.26 | .075 | 54.98 | .075 | 54.70 | .075 | 54.43 | .075 | 54.17 | .075 | 53.92 | .075 | 53.67 | .075 | 53.42 | .075 | 53.18 | .075 | 52.95 | .075 | 52.72 | .075 | 52.50 | .075 |

TABLE 1A. LOGARITHMS OF PER CENT. OF DRY SLIME AND CORRECTION FOR SPECIFIC GRAVITY OF SOLUTION

Specific Gravity of Dry Slime

Weight in Grams of One Liter of Wet Pulp

| | 2.50 | Correction | 2.52 | Correction | 2.54 | Correction | 2.56 | Correction | 2.58 | Correction | 2.60 | Correction | 2.62 | Correction | 2.64 | Correction | 2.66 | Correction | 2.68 | Correction | 2.70 | Correction | 2.72 | Correction | 2.74 | Correction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | .2175 | .1650 | .2154 | .1642 | .2130 | .1633 | .2109 | .1625 | .2087 | .1617 | .2066 | .1609 | .2044 | .1601 | .2025 | .1594 | .2003 | .1586 | .1984 | .1579 | .1967 | .1573 | .1948 | .1566 | .1931 | .1560 |
| 1020 | .5143 | .1623 | .5120 | .1615 | .5097 | .1607 | .5075 | .1598 | .5053 | .1590 | .5032 | .1583 | .5012 | .1575 | .4991 | .1568 | .4972 | .1561 | .4953 | .1555 | .4935 | .1548 | .4915 | .1541 | .4897 | .1535 |
| 1030 | .6861 | .1597 | .6839 | .1589 | .6816 | .1581 | .6794 | .1573 | .6772 | .1565 | .6751 | .1558 | .6731 | .1551 | .6711 | .1544 | .6691 | .1537 | .6672 | .1531 | .6653 | .1525 | .6634 | .1518 | .6616 | .1512 |
| 1040 | .8069 | .1571 | .8047 | .1564 | .8024 | .1556 | .8002 | .1548 | .7980 | .1541 | .7960 | .1534 | .7939 | .1527 | .7918 | .1520 | .7898 | .1513 | .7879 | .1507 | .7860 | .1501 | .7842 | .1495 | .7824 | .1489 |
| 1050 | .8996 | .1545 | .8974 | .1537 | .8951 | .1530 | .8929 | .1523 | .8908 | .1516 | .8887 | .1509 | .8866 | .1502 | .8846 | .1496 | .8826 | .1490 | .8806 | .1484 | .8788 | .1478 | .8769 | .1472 | .8751 | .1466 |
| 1060 | .9747 | .1521 | .9725 | .1514 | .9702 | .1506 | .9680 | .1499 | .9659 | .1492 | .9638 | .1486 | .9617 | .1479 | .9597 | .1473 | .9577 | .1467 | .9557 | .1461 | .9539 | .1455 | .9520 | .1449 | .9502 | .1443 |
| 1070 | .0374 | .149 | .0354 | .149 | .0330 | .148 | .0306 | .147 | .0286 | .146 | .0265 | .146 | .0245 | .145 | .0224 | .145 | .0204 | .144 | .0187 | .144 | .0166 | .143 | .0149 | .143 | .0128 | .142 |
| 1080 | .0913 | .147 | .0892 | .146 | .0871 | .146 | .0849 | .145 | .0828 | .145 | .0806 | .144 | .0785 | .143 | .0763 | .142 | .0745 | .142 | .0726 | .142 | .0708 | .141 | .0689 | .141 | .0671 | .140 |
| 1090 | .1386 | .145 | .1364 | .144 | .1342 | .144 | .1319 | .143 | .1297 | .142 | .1278 | .142 | .1255 | .140 | .1235 | .140 | .1216 | .140 | .1196 | .139 | .1179 | .139 | .1159 | .138 | .1143 | .138 |
| 1100 | .1804 | .143 | .1781 | .142 | .1758 | .141 | .1735 | .140 | .1714 | .140 | .1694 | .139 | .1673 | .139 | .1652 | .138 | .1632 | .137 | .1614 | .137 | .1596 | .137 | .1578 | .137 | .1559 | .136 |
| 1110 | .2180 | .140 | .2156 | .139 | .2133 | .138 | .2111 | .138 | .2090 | .138 | .2071 | .138 | .2049 | .137 | .2028 | .136 | .2009 | .136 | .1989 | .135 | .1970 | .135 | .1951 | .134 | .1934 | .134 |
| 1120 | .2519 | .138 | .2494 | .137 | .2472 | .137 | .2450 | .136 | .2430 | .136 | .2408 | .135 | .2388 | .135 | .2368 | .134 | .2348 | .134 | .2327 | .133 | .2310 | .133 | .2292 | .133 | .2274 | .132 |
| 1130 | .2826 | .135 | .2804 | .135 | .2781 | .134 | .2758 | .133 | .2737 | .133 | .2716 | .132 | .2695 | .132 | .2676 | .132 | .2655 | .131 | .2636 | .131 | .2617 | .130 | .2598 | .130 | .2582 | .130 |
| 1140 | .3111 | .134 | .3088 | .133 | .3064 | .132 | .3043 | .132 | .3021 | .131 | .2999 | .130 | .2980 | .130 | .2960 | .130 | .2940 | .130 | .2920 | .129 | .2903 | .129 | .2882 | .128 | .2865 | .128 |
| 1150 | .3373 | .132 | .3349 | .131 | .3326 | .130 | .3304 | .130 | .3284 | .130 | .3263 | .130 | .3243 | .129 | .3222 | .129 | .3201 | .128 | .3183 | .128 | .3164 | .127 | .3145 | .127 | .3126 | .126 |
| 1160 | .3615 | .130 | .3593 | .129 | .3570 | .129 | .3547 | .128 | .3526 | .127 | .3504 | .127 | .3483 | .126 | .3464 | .126 | .3444 | .126 | .3424 | .125 | .3406 | .125 | .3387 | .124 | .3369 | .124 |
| 1170 | .3840 | .127 | .3817 | .126 | .3795 | .126 | .3773 | .126 | .3751 | .125 | .3731 | .125 | .3711 | .125 | .3690 | .124 | .3670 | .124 | .3651 | .124 | .3632 | .123 | .3614 | .123 | .3595 | .122 |
| 1180 | .4052 | .125 | .4030 | .125 | .4007 | .125 | .3985 | .124 | .3964 | .124 | .3943 | .123 | .3922 | .123 | .3902 | .123 | .3883 | .123 | .3863 | .122 | .3844 | .122 | .3824 | .121 | .3806 | .120 |
| 1190 | .4250 | .123 | .4228 | .123 | .4206 | .123 | .4185 | .122 | .4163 | .122 | .4141 | .121 | .4121 | .121 | .4101 | .121 | .4081 | .120 | .4062 | .120 | .4043 | .120 | .4024 | .119 | .4005 | .118 |
| 1200 | .4436 | .121 | .4414 | .121 | .4392 | .121 | .4370 | .120 | .4347 | .119 | .4326 | .119 | .4306 | .118 | .4286 | .118 | .4267 | .118 | .4247 | .118 | .4228 | .117 | .4209 | .117 | .4191 | .117 |
| 1210 | .4612 | .119 | .4589 | .119 | .4567 | .119 | .4545 | .118 | .4524 | .118 | .4502 | .117 | .4482 | .117 | .4462 | .117 | .4442 | .117 | .4423 | .117 | .4404 | .116 | .4385 | .116 | .4366 | .115 |
| 1220 | .4778 | .118 | .4755 | .117 | .4733 | .117 | .4711 | .116 | .4689 | .116 | .4669 | .116 | .4648 | .115 | .4628 | .115 | .4608 | .114 | .4588 | .114 | .4570 | .114 | .4551 | .114 | .4533 | .114 |
| 1230 | .4936 | .115 | .4914 | .115 | .4891 | .115 | .4869 | .114 | .4847 | .114 | .4827 | .114 | .4806 | .113 | .4786 | .113 | .4766 | .113 | .4747 | .113 | .4729 | .112 | .4709 | .112 | .4690 | .111 |
| 1240 | .5087 | .114 | .5064 | .114 | .5041 | .113 | .5019 | .113 | .4997 | .112 | .4976 | .112 | .4955 | .112 | .4936 | .112 | .4916 | .112 | .4897 | .112 | .4878 | .112 | .4860 | .111 | .4842 | .111 |
| 1250 | .5228 | .112 | .5206 | .112 | .5184 | .112 | .5161 | .111 | .5140 | .111 | .5119 | .110 | .5099 | .110 | .5079 | .110 | .5058 | .110 | .5038 | .109 | .5019 | .109 | .5001 | .109 | .4983 | .109 |
| 1260 | .5354 | .111 | .5342 | .111 | .5319 | .110 | .5297 | .110 | .5275 | .109 | .5254 | .109 | .5234 | .109 | .5214 | .109 | .5194 | .109 | .5175 | .109 | .5156 | .108 | .5138 | .108 | .5119 | .108 |
| 1270 | .5494 | .108 | .5472 | .108 | .5449 | .108 | .5427 | .108 | .5406 | .108 | .5384 | .108 | .5364 | .107 | .5344 | .107 | .5324 | .106 | .5305 | .106 | .5285 | .106 | .5266 | .106 | .5248 | .105 |
| 1280 | .5618 | .107 | .5595 | .107 | .5573 | .106 | .5551 | .106 | .5529 | .106 | .5508 | .105 | .5488 | .105 | .5468 | .105 | .5448 | .105 | .5428 | .105 | .5410 | .105 | .5391 | .104 | .5372 | .104 |
| 1290 | .5736 | .104 | .5714 | .104 | .5691 | .104 | .5669 | .104 | .5648 | .104 | .5626 | .104 | .5606 | .103 | .5586 | .103 | .5566 | .103 | .5546 | .103 | .5528 | .103 | .5510 | .102 | .5491 | .102 |
| 1300 | .5850 | .103 | .5827 | .103 | .5805 | .102 | .5783 | .102 | .5761 | .102 | .5740 | .102 | .5719 | .102 | .5700 | .102 | .5680 | .102 | .5661 | .102 | .5642 | .102 | .5623 | .101 | .5604 | .101 |
| 1310 | .5959 | .102 | .5936 | .102 | .5914 | .101 | .5892 | .101 | .5870 | .101 | .5849 | .101 | .5829 | .101 | .5808 | .101 | .5789 | .100 | .5769 | .100 | .5751 | .100 | .5732 | .100 | .5714 | .100 |
| 1320 | .6064 | .100 | .6041 | .100 | .6018 | .099 | .5997 | .099 | .5975 | .099 | .5954 | .098 | .5933 | .098 | .5913 | .098 | .5893 | .098 | .5874 | .098 | .5855 | .098 | .5835 | .097 | .5817 | .097 |
| 1330 | .6164 | .098 | .6142 | .098 | .6119 | .098 | .6097 | .098 | .6076 | .098 | .6055 | .098 | .6035 | .098 | .6014 | .098 | .5993 | .097 | .5974 | .097 | .5955 | .097 | .5936 | .096 | .5918 | .096 |
| 1340 | .6262 | .098 | .6240 | .098 | .6217 | .097 | .6195 | .097 | .6173 | .097 | .6152 | .096 | .6132 | .096 | .6112 | .096 | .6092 | .096 | .6072 | .096 | .6053 | .096 | .6035 | .095 | .6016 | .095 |
| 1350 | .6356 | .095 | .6334 | .095 | .6311 | .095 | .6289 | .095 | .6268 | .095 | .6247 | .095 | .6226 | .095 | .6206 | .095 | .6186 | .095 | .6167 | .095 | .6148 | .095 | .6129 | .094 | .6111 | .094 |
| 1360 | .6446 | .094 | .6424 | .094 | .6401 | .094 | .6379 | .093 | .6358 | .093 | .6337 | .093 | .6316 | .093 | .6296 | .093 | .6276 | .093 | .6256 | .093 | .6238 | .093 | .6219 | .092 | .6200 | .092 |
| 1370 | .6533 | .092 | .6511 | .092 | .6488 | .092 | .6466 | .092 | .6444 | .092 | .6424 | .092 | .6403 | .092 | .6383 | .092 | .6363 | .092 | .6344 | .092 | .6325 | .092 | .6306 | .091 | .6288 | .091 |
| 1380 | .6617 | .091 | .6594 | .091 | .6572 | .091 | .6549 | .091 | .6528 | .091 | .6508 | .091 | .6488 | .091 | .6467 | .091 | .6447 | .091 | .6428 | .091 | .6409 | .091 | .6390 | .091 | .6372 | .091 |
| 1390 | .6699 | .089 | .6676 | .089 | .6654 | .089 | .6632 | .089 | .6611 | .089 | .6590 | .089 | .6569 | .089 | .6548 | .089 | .6529 | .089 | .6510 | .089 | .6491 | .089 | .6473 | .089 | .6454 | .089 |
| 1400 | .6779 | .089 | .6756 | .089 | .6733 | .088 | .6711 | .088 | .6689 | .088 | .6669 | .088 | .6648 | .088 | .6628 | .088 | .6608 | .088 | .6589 | .088 | .6570 | .088 | .6551 | .087 | .6533 | .087 |
| 1410 | .6854 | .086 | .6831 | .086 | .6809 | .086 | .6787 | .086 | .6766 | .086 | .6745 | .086 | .6725 | .086 | .6704 | .086 | .6684 | .086 | .6664 | .086 | .6645 | .086 | .6627 | .086 | .6609 | .086 |
| 1420 | .6927 | .084 | .6905 | .084 | .6882 | .084 | .6860 | .084 | .6839 | .084 | .6818 | .084 | .6797 | .084 | .6777 | .084 | .6757 | .084 | .6738 | .084 | .6719 | .084 | .6701 | .084 | .6682 | .084 |
| 1430 | .7000 | .084 | .6978 | .084 | .6955 | .084 | .6933 | .084 | .6912 | .084 | .6890 | .084 | .6870 | .084 | .6849 | .084 | .6830 | .084 | .6810 | .084 | .6791 | .084 | .6772 | .084 | .6754 | .084 |
| 1440 | .7069 | .082 | .7047 | .082 | .7024 | .082 | .7002 | .082 | .6980 | .082 | .6959 | .082 | .6939 | .082 | .6919 | .082 | .6898 | .082 | .6879 | .082 | .6860 | .082 | .6841 | .082 | .6823 | .082 |
| 1450 | .7137 | .081 | .7114 | .081 | .7091 | .080 | .7069 | .080 | .7048 | .080 | .7027 | .080 | .7006 | .080 | .6986 | .080 | .6966 | .080 | .6947 | .080 | .6928 | .080 | .6909 | .080 | .6890 | .080 |
| 1460 | .7202 | .080 | .7179 | .080 | .7157 | .080 | .7135 | .080 | .7114 | .080 | .7093 | .080 | .7072 | .080 | .7052 | .080 | .7032 | .080 | .7012 | .080 | .6993 | .080 | .6975 | .080 | .6957 | .080 |
| 1470 | .7266 | .078 | .7244 | .078 | .7221 | .078 | .7199 | .078 | .7177 | .078 | .7157 | .078 | .7136 | .078 | .7116 | .078 | .7096 | .078 | .7077 | .078 | .7058 | .078 | .7039 | .078 | .7021 | .078 |
| 1480 | .7327 | .077 | .7305 | .077 | .7282 | .077 | .7260 | .077 | .7239 | .077 | .7217 | .077 | .7197 | .077 | .7177 | .077 | .7157 | .077 | .7137 | .077 | .7119 | .077 | .7100 | .077 | .7082 | .077 |
| 1490 | .7388 | .076 | .7366 | .076 | .7343 | .076 | .7321 | .077 | .7300 | .077 | .7279 | .077 | .7258 | .077 | .7238 | .077 | .7218 | .077 | .7198 | .077 | .7179 | .077 | .7161 | .077 | .7142 | .077 |
| 1500 | .7447 | .075 | .7424 | .075 | .7402 | .075 | .7380 | .075 | .7358 | .075 | .7338 | .075 | .7317 | .076 | .7297 | .076 | .7277 | .076 | .7257 | .076 | .7239 | .076 | .7220 | .076 | .7202 | .076 |

Note—The natural values are given for the corrections on account of the manner in which they are applied.

by weighing with a Fairbanks registering scale, making proper allowance for moisture, checks the tonnage as determined in the cyanide plant by the specific-gravity method within one-eighth of one per cent., the specific-gravity method giving the higher result.

NOTE—The characteristics of the logarithms in Table 1A are not given. They are 0. for all values up to 1070 of "weight in grams of one liter of wet pulp," and for the last few columns of 1070. For all values above 1070 and most of 1070 the value is 1. The point of change of the characteristic from zero to unity can be seen by the change of the mantissa from .009+ to .000—. It can also be determined by looking up the antilogarithm in Table 1, and determining as usual in such work the characteristic of the logarithm of that number.

TABLE 1. PER CENT. OF DRY SLIME AND CORRECTION FOR SPECIFIC GRAVITY OF SOLUTION—Continued

Formula: $P = \frac{100\,S\,(a-d)}{a\,(S-d)}$

Specific Gravity of Dry Slime

| 2.76 | Correction | 2.78 | Correction | 2.80 | Correction | 2.82 | Correction | 2.84 | Correction | 2.86 | Correction | 2.88 | Correction | 2.90 | Correction | 2.92 | Correction | 2.94 | Correction | 2.96 | Correction | 2.98 | Correction | 3.00 | Correction | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.553 | .1553 | 1.546 | .1546 | 1.540 | .1540 | 1.534 | .1534 | 1.528 | .1528 | 1.523 | .1523 | 1.517 | .1517 | 1.511 | .1511 | 1.506 | .1506 | 1.500 | .1500 | 1.495 | .1495 | 1.490 | .1490 | 1.485 | .1485 | 1010 |
| 3.075 | .1529 | 3.062 | .1522 | 3.050 | .1516 | 3.038 | .1510 | 3.026 | .1505 | 3.015 | .1499 | 3.003 | .1493 | 2.992 | .1488 | 2.982 | .1483 | 2.971 | .1478 | 2.961 | .1473 | 2.951 | .1468 | 2.941 | .1463 | 1020 |
| 4.568 | .1505 | 4.543 | .1499 | 4.531 | .1494 | 4.513 | .1488 | 4.496 | .1483 | 4.479 | .1477 | 4.462 | .1471 | 4.446 | .1466 | 4.430 | .1461 | 4.414 | .1456 | 4.398 | .1451 | 4.383 | .1446 | 4.369 | .1442 | 1030 |
| 6.033 | .1483 | 6.008 | .1477 | 5.984 | .1472 | 5.960 | .1466 | 5.937 | .1460 | 5.915 | .1455 | 5.893 | .1450 | 5.871 | .1445 | 5.850 | .1440 | 5.829 | .1435 | 5.809 | .1430 | 5.789 | .1426 | 5.770 | .1422 | 1040 |
| 7.468 | .1460 | 7.437 | .1454 | 7.408 | .1448 | 7.378 | .1443 | 7.350 | .1438 | 7.323 | .1433 | 7.295 | .1427 | 7.268 | .1422 | 7.243 | .1418 | 7.216 | .1413 | 7.191 | .1408 | 7.166 | .1404 | 7.143 | .1400 | 1050 |
| 8.878 | .1437 | 8.841 | .1432 | 8.806 | .1427 | 8.771 | .1423 | 8.738 | .1418 | 8.705 | .1412 | 8.672 | .1406 | 8.640 | .1401 | 8.610 | .1397 | 8.578 | .1393 | 8.549 | .1388 | 8.519 | .1384 | 8.491 | .1380 | 1060 |
| 10.26 | .142 | 10.22 | .141 | 10.18 | .141 | 10.14 | .140 | 10.10 | .140 | 10.06 | .139 | 10.02 | .138 | 9.984 | .1380 | 9.948 | .1375 | 9.913 | .1371 | 9.879 | .1367 | 9.845 | .1363 | 9.812 | .1360 | 1070 |
| 11.62 | .140 | 11.57 | .139 | 11.52 | .138 | 11.48 | .138 | 11.44 | .138 | 11.39 | .138 | 11.35 | .137 | 11.31 | .137 | 11.27 | .136 | 11.23 | .136 | 11.19 | .135 | 11.15 | .135 | 11.11 | .134 | 1080 |
| 12.95 | .137 | 12.90 | .137 | 12.84 | .136 | 12.79 | .136 | 12.74 | .135 | 12.70 | .135 | 12.65 | .134 | 12.60 | .134 | 12.55 | .133 | 12.51 | .133 | 12.47 | .133 | 12.43 | .133 | 12.39 | .133 | 1090 |
| 14.26 | .136 | 14.20 | .135 | 14.14 | .134 | 14.08 | .134 | 14.03 | .134 | 13.98 | .133 | 13.93 | .133 | 13.88 | .133 | 13.83 | .132 | 13.78 | .132 | 13.73 | .131 | 13.68 | .131 | 13.63 | .130 | 1100 |
| 15.54 | .133 | 15.48 | .133 | 15.42 | .133 | 15.36 | .133 | 15.30 | .132 | 15.24 | .131 | 15.18 | .130 | 15.12 | .130 | 15.07 | .130 | 15.02 | .130 | 14.97 | .129 | 14.92 | .129 | 14.87 | .129 | 1110 |
| 16.80 | .131 | 16.73 | .131 | 16.67 | .131 | 16.60 | .130 | 16.54 | .130 | 16.48 | .129 | 16.41 | .128 | 16.35 | .128 | 16.30 | .128 | 16.24 | .128 | 16.18 | .127 | 16.13 | .127 | 16.08 | .127 | 1120 |
| 18.04 | .129 | 17.96 | .128 | 17.89 | .128 | 17.82 | .128 | 17.75 | .127 | 17.69 | .127 | 17.62 | .126 | 17.56 | .126 | 17.49 | .126 | 17.43 | .125 | 17.37 | .125 | 17.31 | .125 | 17.25 | .124 | 1130 |
| 19.26 | .128 | 19.18 | .127 | 19.10 | .126 | 19.02 | .126 | 18.95 | .126 | 18.88 | .125 | 18.81 | .125 | 18.74 | .125 | 18.68 | .125 | 18.61 | .124 | 18.54 | .123 | 18.48 | .123 | 18.42 | .123 | 1140 |
| 20.45 | .125 | 20.37 | .125 | 20.29 | .125 | 20.21 | .125 | 20.13 | .124 | 20.06 | .124 | 19.98 | .123 | 19.91 | .123 | 19.84 | .123 | 19.77 | .123 | 19.70 | .122 | 19.63 | .122 | 19.57 | .122 | 1150 |
| 21.63 | .124 | 21.54 | .123 | 21.45 | .123 | 21.37 | .123 | 21.29 | .123 | 21.21 | .122 | 21.13 | .121 | 21.05 | .121 | 20.97 | .120 | 20.90 | .120 | 20.83 | .120 | 20.75 | .119 | 20.68 | .119 | 1160 |
| 22.78 | .121 | 22.69 | .121 | 22.60 | .121 | 22.51 | .121 | 22.42 | .121 | 22.34 | .120 | 22.25 | .119 | 22.17 | .119 | 22.10 | .119 | 22.02 | .119 | 21.94 | .118 | 21.86 | .118 | 21.79 | .118 | 1170 |
| 23.92 | .120 | 23.82 | .120 | 23.73 | .120 | 23.64 | .120 | 23.55 | .119 | 23.46 | .119 | 23.37 | .118 | 23.28 | .118 | 23.20 | .118 | 23.12 | .118 | 23.04 | .117 | 22.96 | .117 | 22.88 | .117 | 1180 |
| 25.04 | .118 | 24.94 | .118 | 24.84 | .118 | 24.74 | .117 | 24.65 | .117 | 24.55 | .117 | 24.46 | .116 | 24.37 | .116 | 24.29 | .116 | 24.20 | .116 | 24.11 | .115 | 24.03 | .115 | 23.95 | .115 | 1190 |
| 26.14 | .117 | 26.03 | .116 | 25.92 | .115 | 25.82 | .115 | 25.72 | .115 | 25.63 | .115 | 25.53 | .115 | 25.44 | .115 | 25.34 | .114 | 25.25 | .113 | 25.16 | .113 | 25.08 | .113 | 25.00 | .113 | 1200 |
| 27.21 | .115 | 27.10 | .114 | 26.99 | .114 | 26.89 | .114 | 26.79 | .114 | 26.69 | .113 | 26.59 | .113 | 26.49 | .113 | 26.39 | .113 | 26.30 | .112 | 26.21 | .112 | 26.12 | .112 | 26.03 | .112 | 1210 |
| 28.28 | .113 | 28.16 | .113 | 28.05 | .113 | 27.94 | .113 | 27.83 | .112 | 27.72 | .111 | 27.62 | .111 | 27.52 | .111 | 27.42 | .111 | 27.32 | .111 | 27.23 | .111 | 27.14 | .111 | 27.05 | .111 | 1220 |
| 29.32 | .111 | 29.20 | .111 | 29.09 | .111 | 28.97 | .111 | 28.86 | .111 | 28.75 | .110 | 28.64 | .109 | 28.54 | .109 | 28.44 | .109 | 28.34 | .109 | 28.24 | .109 | 28.14 | .109 | 28.05 | .109 | 1230 |
| 30.36 | .110 | 30.23 | .110 | 30.11 | .110 | 29.99 | .110 | 29.87 | .109 | 29.76 | .109 | 29.65 | .108 | 29.54 | .108 | 29.43 | .107 | 29.33 | .107 | 29.23 | .107 | 29.13 | .107 | 29.03 | .107 | 1240 |
| 31.37 | .109 | 31.24 | .109 | 31.11 | .108 | 30.99 | .108 | 30.87 | .108 | 30.75 | .107 | 30.63 | .106 | 30.52 | .106 | 30.41 | .106 | 30.30 | .106 | 30.20 | .106 | 30.10 | .106 | 30.00 | .106 | 1250 |
| 32.35 | .108 | 32.23 | .107 | 32.10 | .107 | 31.97 | .107 | 31.85 | .107 | 31.73 | .106 | 31.61 | .105 | 31.49 | .105 | 31.38 | .105 | 31.27 | .105 | 31.16 | .105 | 31.05 | .104 | 30.95 | .104 | 1260 |
| 33.34 | .105 | 33.20 | .105 | 33.07 | .105 | 32.94 | .105 | 32.81 | .105 | 32.69 | .104 | 32.57 | .104 | 32.45 | .104 | 32.33 | .104 | 32.22 | .104 | 32.11 | .104 | 32.00 | .103 | 31.89 | .103 | 1270 |
| 34.31 | .104 | 34.17 | .103 | 34.03 | .103 | 33.89 | .103 | 33.76 | .103 | 33.63 | .102 | 33.51 | .102 | 33.39 | .102 | 33.27 | .102 | 33.15 | .102 | 33.04 | .102 | 32.93 | .102 | 32.82 | .102 | 1280 |
| 35.26 | .102 | 35.11 | .102 | 34.97 | .102 | 34.83 | .102 | 34.70 | .101 | 34.57 | .101 | 34.44 | .101 | 34.31 | .101 | 34.19 | .100 | 34.07 | .100 | 33.95 | .100 | 33.83 | .100 | 33.72 | .100 | 1290 |
| 36.19 | .101 | 36.04 | .100 | 35.90 | .100 | 35.76 | .100 | 35.62 | .099 | 35.48 | .099 | 35.35 | .099 | 35.22 | .099 | 35.09 | .098 | 34.97 | .098 | 34.85 | .098 | 34.73 | .098 | 34.62 | .098 | 1300 |
| 37.11 | .100 | 36.96 | .099 | 36.81 | .099 | 36.67 | .099 | 36.53 | .098 | 36.39 | .098 | 36.25 | .098 | 36.12 | .098 | 35.99 | .097 | 35.87 | .097 | 35.74 | .097 | 35.62 | .097 | 35.50 | .097 | 1310 |
| 38.01 | .097 | 37.85 | .097 | 37.70 | .097 | 37.55 | .097 | 37.41 | .097 | 37.27 | .096 | 37.13 | .096 | 36.99 | .096 | 36.86 | .096 | 36.73 | .096 | 36.60 | .096 | 36.48 | .096 | 36.36 | .096 | 1320 |
| 38.91 | .096 | 38.75 | .096 | 38.59 | .096 | 38.44 | .096 | 38.29 | .096 | 38.15 | .095 | 38.01 | .095 | 37.87 | .095 | 37.73 | .095 | 37.59 | .095 | 37.46 | .095 | 37.33 | .095 | 37.21 | .095 | 1330 |
| 39.79 | .095 | 39.63 | .095 | 39.47 | .095 | 39.31 | .095 | 39.16 | .094 | 39.01 | .094 | 38.87 | .094 | 38.73 | .094 | 38.59 | .094 | 38.45 | .094 | 38.32 | .094 | 38.19 | .094 | 38.06 | .094 | 1340 |
| 40.67 | .094 | 40.50 | .094 | 40.34 | .094 | 40.18 | .094 | 40.02 | .093 | 39.87 | .093 | 39.72 | .093 | 39.57 | .093 | 39.43 | .093 | 39.29 | .093 | 39.16 | .093 | 39.03 | .093 | 38.90 | .093 | 1350 |
| 41.51 | .092 | 41.34 | .092 | 41.18 | .092 | 41.02 | .092 | 40.86 | .092 | 40.71 | .092 | 40.56 | .092 | 40.41 | .091 | 40.26 | .091 | 40.12 | .091 | 39.98 | .091 | 39.84 | .091 | 39.71 | .091 | 1360 |
| 42.36 | .091 | 42.18 | .091 | 42.01 | .091 | 41.84 | .091 | 41.68 | .090 | 41.52 | .090 | 41.37 | .090 | 41.22 | .090 | 41.07 | .090 | 40.93 | .090 | 40.79 | .090 | 40.65 | .090 | 40.51 | .090 | 1370 |
| 43.19 | .090 | 43.01 | .089 | 42.83 | .089 | 42.66 | .089 | 42.50 | .089 | 42.34 | .089 | 42.18 | .089 | 42.03 | .089 | 41.88 | .089 | 41.73 | .089 | 41.58 | .089 | 41.44 | .089 | 41.30 | .089 | 1380 |
| 44.01 | .089 | 43.83 | .088 | 43.65 | .088 | 43.48 | .088 | 43.32 | .088 | 43.15 | .088 | 42.99 | .088 | 42.83 | .087 | 42.67 | .087 | 42.52 | .087 | 42.37 | .087 | 42.23 | .087 | 42.09 | .087 | 1390 |
| 44.82 | .087 | 44.63 | .087 | 44.45 | .087 | 44.27 | .087 | 44.10 | .087 | 43.93 | .087 | 43.77 | .086 | 43.61 | .086 | 43.45 | .086 | 43.30 | .086 | 43.15 | .086 | 43.00 | .086 | 42.86 | .086 | 1400 |
| 45.61 | .086 | 45.42 | .086 | 45.24 | .086 | 45.06 | .086 | 44.89 | .086 | 44.72 | .086 | 44.55 | .085 | 44.38 | .085 | 44.22 | .085 | 44.06 | .085 | 43.91 | .085 | 43.76 | .085 | 43.62 | .085 | 1410 |
| 46.38 | .084 | 46.19 | .084 | 46.00 | .084 | 45.82 | .084 | 45.64 | .084 | 45.47 | .085 | 45.30 | .084 | 45.14 | .084 | 44.97 | .084 | 44.81 | .084 | 44.66 | .084 | 44.51 | .084 | 44.36 | .084 | 1420 |
| 47.16 | .083 | 46.97 | .083 | 46.78 | .083 | 46.59 | .083 | 46.41 | .083 | 46.24 | .083 | 46.07 | .083 | 45.90 | .083 | 45.74 | .083 | 45.58 | .083 | 45.42 | .083 | 45.26 | .083 | 45.11 | .083 | 1430 |
| 47.92 | .082 | 47.72 | .082 | 47.53 | .082 | 47.34 | .082 | 47.16 | .082 | 46.98 | .082 | 46.81 | .082 | 46.64 | .082 | 46.47 | .082 | 46.30 | .082 | 46.14 | .082 | 45.98 | .082 | 45.83 | .082 | 1440 |
| 48.66 | .080 | 48.46 | .080 | 48.26 | .080 | 48.08 | .080 | 47.90 | .080 | 47.72 | .080 | 47.54 | .080 | 47.36 | .080 | 47.19 | .080 | 47.02 | .080 | 46.86 | .080 | 46.70 | .080 | 46.55 | .080 | 1450 |
| 49.41 | .079 | 49.21 | .079 | 49.01 | .079 | 48.82 | .079 | 48.63 | .079 | 48.45 | .079 | 48.27 | .079 | 48.09 | .079 | 47.91 | .079 | 47.74 | .079 | 47.57 | .079 | 47.41 | .079 | 47.26 | .079 | 1460 |
| 50.15 | .078 | 49.94 | .078 | 49.74 | .078 | 49.54 | .078 | 49.35 | .078 | 49.16 | .078 | 48.98 | .078 | 48.80 | .078 | 48.62 | .078 | 48.45 | .078 | 48.28 | .078 | 48.12 | .078 | 47.96 | .078 | 1470 |
| 50.85 | .077 | 50.64 | .077 | 50.45 | .077 | 50.24 | .077 | 50.05 | .077 | 49.86 | .077 | 49.68 | .077 | 49.50 | .077 | 49.32 | .077 | 49.14 | .077 | 48.97 | .077 | 48.80 | .077 | 48.64 | .077 | 1480 |
| 51.57 | .076 | 51.36 | .076 | 51.16 | .076 | 50.95 | .076 | 50.76 | .076 | 50.57 | .076 | 50.38 | .076 | 50.19 | .076 | 50.01 | .076 | 49.83 | .076 | 49.66 | .076 | 49.49 | .076 | 49.33 | .076 | 1490 |
| 52.28 | .075 | 52.06 | .075 | 51.85 | .075 | 51.65 | .075 | 51.45 | .075 | 51.26 | .075 | 51.07 | .075 | 50.88 | .075 | 50.69 | .075 | 50.51 | .075 | 50.34 | .075 | 50.17 | .075 | 50.00 | .075 | 1500 |

Weight in Grams of One Liter of Wet Pulp

TABLE IA. LOGARITHMS OF PER CENT. OF DRY SLIME AND CORRECTION FOR SPECIFIC GRAVITY OF SOLUTION—Continued

Specific Gravity of Dry Slime

| 2.76 | Correction | 2.78 | Correction | 2.80 | Correction | 2.82 | Correction | 2.84 | Correction | 2.86 | Correction | 2.88 | Correction | 2.90 | Correction | 2.92 | Correction | 2.94 | Correction | 2.96 | Correction | 2.98 | Correction | 3.00 | Correction | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .1912 | .1553 | .1892 | .1546 | .1875 | .1540 | .1858 | .1534 | .1841 | .1528 | .1827 | .1523 | .1810 | .1517 | .1793 | .1511 | .1778 | .1506 | .1761 | .1500 | .1746 | .1495 | .1732 | .1490 | .1717 | .1485 | 1010 |
| .4878 | .1529 | .4860 | .1522 | .4843 | .1516 | .4826 | .1510 | .4809 | .1505 | .4793 | .1499 | .4776 | .1493 | .4760 | .1488 | .4745 | .1483 | .4729 | .1478 | .4714 | .1473 | .4700 | .1468 | .4685 | .1463 | 1020 |
| .6507 | .1505 | .6579 | .1499 | .6562 | .1494 | .6545 | .1488 | .6528 | .1483 | .6512 | .1477 | .6496 | .1471 | .6480 | .1466 | .6464 | .1461 | .6448 | .1456 | .6433 | .1451 | .6418 | .1446 | .6404 | .1442 | 1030 |
| .7805 | .1483 | .7787 | .1477 | .7770 | .1472 | .7752 | .1466 | .7736 | .1460 | .7720 | .1455 | .7703 | .1450 | .7687 | .1445 | .7672 | .1440 | .7656 | .1435 | .7641 | .1430 | .7626 | .1426 | .7612 | .1422 | 1040 |
| .8732 | .1460 | .8714 | .1454 | .8697 | .1448 | .8679 | .1443 | .8663 | .1438 | .8647 | .1433 | .8630 | .1427 | .8614 | .1422 | .8599 | .1413 | .8583 | .1413 | .8568 | .1408 | .8553 | .1404 | .8539 | .1400 | 1050 |
| .9483 | .1437 | .9465 | .1432 | .9448 | .1427 | .9430 | .1423 | .9414 | .1418 | .9398 | .1412 | .9381 | .1406 | .9365 | .1401 | .9350 | .1397 | .9334 | .1393 | .9319 | .1388 | .9304 | .1384 | .9290 | .1380 | 1060 |
| .0111 | .142 | .0094 | .141 | .0077 | .141 | .0060 | .140 | .0043 | .140 | .0026 | .139 | .0009 | .138 | .9993 | .1380 | .9977 | .1375 | .9962 | .1371 | .9947 | .1367 | .9932 | .1363 | .9918 | .1360 | 1070 |
| .0652 | .140 | .0633 | .139 | .0615 | .138 | .0599 | .138 | .0584 | .138 | .0565 | .138 | .0549 | .137 | .0535 | .137 | .0519 | .136 | .0504 | .136 | .0488 | .135 | .0473 | .135 | .0457 | .134 | 1080 |
| .1123 | .137 | .1106 | .137 | .1086 | .136 | .1069 | .136 | .1052 | .135 | .1038 | .135 | .1021 | .134 | .1004 | .134 | .0987 | .133 | .0973 | .133 | .0959 | .133 | .0945 | .130 | .0931 | .133 | 1090 |
| .1541 | .136 | .1523 | .135 | .1504 | .134 | .1486 | .134 | .1471 | .134 | .1455 | .133 | .1439 | .133 | .1424 | .133 | .1408 | .132 | .1392 | .132 | .1377 | .131 | .1361 | .131 | .1345 | .130 | 1100 |
| .1915 | .133 | .1898 | .133 | .1881 | .133 | .1864 | .133 | .1847 | .132 | .1830 | .131 | .1813 | .130 | .1796 | .130 | .1781 | .130 | .1767 | .130 | .1752 | .129 | .1738 | .129 | .1723 | .129 | 1110 |
| .2253 | .131 | .2235 | .131 | .2219 | .131 | .2201 | .130 | .2185 | .130 | .2170 | .129 | .2161 | .128 | .2135 | .128 | .2122 | .128 | .2106 | .128 | .2090 | .127 | .2076 | .127 | .2063 | .127 | 1120 |
| .2562 | .128 | .2543 | .128 | .2526 | .128 | .2509 | .128 | .2492 | .127 | .2477 | .127 | .2460 | .126 | .2445 | .126 | .2428 | .125 | .2413 | .125 | .2398 | .125 | .2383 | .125 | .2368 | .124 | 1130 |
| .2847 | .128 | .2828 | .127 | .2810 | .126 | .2792 | .126 | .2776 | .126 | .2760 | .125 | .2744 | .125 | .2728 | .125 | .2714 | .125 | .2697 | .124 | .2681 | .123 | .2667 | .123 | .2653 | .123 | 1140 |
| .3107 | .125 | .3090 | .125 | .3073 | .125 | .3056 | .125 | .3038 | .124 | .3023 | .124 | .3006 | .123 | .2991 | .123 | .2975 | .123 | .2960 | .123 | .2945 | .122 | .2929 | .122 | .2915 | .122 | 1150 |
| .3351 | .124 | .3332 | .123 | .3314 | .123 | .3298 | .123 | .3282 | .123 | .3265 | .122 | .3249 | .121 | .3233 | .121 | .3216 | .120 | .3201 | .120 | .3187 | .120 | .3170 | .119 | .3156 | .119 | 1160 |
| .3576 | .121 | .3558 | .121 | .3541 | .121 | .3524 | .121 | .3506 | .120 | .3491 | .120 | .3473 | .119 | .3458 | .119 | .3444 | .119 | .3428 | .119 | .3412 | .118 | .3397 | .118 | .3383 | .118 | 1170 |
| .3788 | .120 | .3769 | .120 | .3753 | .120 | .3736 | .120 | .3720 | .120 | .3703 | .119 | .3687 | .118 | .3670 | .118 | .3655 | .118 | .3640 | .118 | .3625 | .117 | .3610 | .117 | .3595 | .117 | 1180 |
| .3986 | .118 | .3969 | .118 | .3952 | .118 | .3934 | .117 | .3918 | .117 | .3901 | .116 | .3885 | .116 | .3869 | .116 | .3854 | .116 | .3838 | .116 | .3822 | .115 | .3808 | .115 | .3793 | .115 | 1190 |
| .4173 | .117 | .4155 | .116 | .4136 | .115 | .4120 | .115 | .4103 | .115 | .4087 | .115 | .4071 | .115 | .4055 | .115 | .4038 | .114 | .4023 | .113 | .4007 | .113 | .3993 | .113 | .3979 | .113 | 1200 |
| .4347 | .114 | .4330 | .114 | .4312 | .114 | .4296 | .114 | .4280 | .114 | .4263 | .114 | .4247 | .113 | .4231 | .113 | .4214 | .112 | .4200 | .112 | .4185 | .112 | .4170 | .112 | .4155 | .112 | 1210 |
| .4515 | .113 | .4496 | .113 | .4479 | .113 | .4462 | .113 | .4445 | .112 | .4428 | .111 | .4412 | .111 | .4396 | .111 | .4381 | .111 | .4365 | .111 | .4350 | .111 | .4336 | .111 | .4322 | .111 | 1220 |
| .4672 | .111 | .4654 | .111 | .4637 | .111 | .4619 | .111 | .4603 | .111 | .4586 | .110 | .4570 | .109 | .4554 | .109 | .4539 | .109 | .4524 | .109 | .4509 | .109 | .4493 | .109 | .4479 | .109 | 1230 |
| .4823 | .111 | .4804 | .110 | .4787 | .110 | .4770 | .110 | .4752 | .109 | .4736 | .109 | .4720 | .108 | .4704 | .108 | .4688 | .107 | .4673 | .107 | .4658 | .107 | .4643 | .107 | .4629 | .107 | 1240 |
| .4965 | .109 | .4947 | .109 | .4929 | .108 | .4912 | .108 | .4895 | .108 | .4878 | .107 | .4861 | .106 | .4846 | .106 | .4830 | .106 | .4814 | .106 | .4800 | .106 | .4786 | .106 | .4771 | .106 | 1250 |
| .5100 | .108 | .5083 | .108 | .5065 | .108 | .5047 | .107 | .5031 | .107 | .5015 | .106 | .4998 | .106 | .4982 | .105 | .4967 | .105 | .4951 | .105 | .4936 | .105 | .4921 | .104 | .4907 | .104 | 1260 |
| .5230 | .105 | .5211 | .105 | .5194 | .105 | .5177 | .105 | .5160 | .105 | .5144 | .104 | .5128 | .104 | .5112 | .104 | .5096 | .104 | .5081 | .104 | .5066 | .104 | .5051 | .103 | .5036 | .103 | 1270 |
| .5354 | .104 | .5336 | .103 | .5319 | .103 | .5301 | .103 | .5284 | .103 | .5267 | .102 | .5252 | .102 | .5236 | .102 | .5220 | .102 | .5205 | .102 | .5190 | .102 | .5176 | .102 | .5161 | .102 | 1280 |
| .5473 | .102 | .5454 | .102 | .5437 | .102 | .5420 | .102 | .5403 | .101 | .5387 | .101 | .5371 | .101 | .5354 | .100 | .5339 | .100 | .5324 | .100 | .5308 | .100 | .5293 | .100 | .5279 | .100 | 1290 |
| .5586 | .101 | .5568 | .100 | .5551 | .100 | .5534 | .100 | .5517 | .099 | .5500 | .099 | .5484 | .099 | .5468 | .098 | .5452 | .098 | .5437 | .098 | .5422 | .098 | .5407 | .098 | .5393 | .098 | 1300 |
| .5695 | .100 | .5677 | .099 | .5660 | .099 | .5643 | .099 | .5626 | .099 | .5610 | .099 | .5593 | .099 | .5577 | .098 | .5562 | .098 | .5546 | .098 | .5532 | .098 | .5517 | .098 | .5502 | .098 | 1310 |
| .5799 | .097 | .5782 | .097 | .5766 | .096 | .5749 | .096 | .5733 | .096 | .5717 | .096 | .5697 | .096 | .5681 | .095 | .5666 | .095 | .5650 | .095 | .5635 | .095 | .5620 | .095 | .5606 | .095 | 1320 |
| .5901 | .096 | .5883 | .096 | .5865 | .096 | .5848 | .096 | .5831 | .096 | .5815 | .096 | .5799 | .096 | .5783 | .095 | .5767 | .095 | .5751 | .095 | .5736 | .095 | .5721 | .095 | .5707 | .095 | 1330 |
| .5998 | .095 | .5980 | .095 | .5963 | .095 | .5945 | .095 | .5928 | .094 | .5912 | .094 | .5896 | .094 | .5880 | .094 | .5865 | .094 | .5849 | .094 | .5834 | .094 | .5819 | .094 | .5805 | .094 | 1340 |
| .6093 | .094 | .6075 | .094 | .6057 | .094 | .6040 | .094 | .6023 | .093 | .6007 | .093 | .5990 | .093 | .5974 | .093 | .5958 | .093 | .5943 | .093 | .5928 | .093 | .5914 | .093 | .5899 | .093 | 1350 |
| .6182 | .092 | .6164 | .092 | .6147 | .092 | .6130 | .092 | .6113 | .092 | .6097 | .092 | .6081 | .092 | .6065 | .091 | .6049 | .091 | .6034 | .091 | .6018 | .091 | .6003 | .091 | .5989 | .091 | 1360 |
| .6270 | .091 | .6251 | .091 | .6234 | .091 | .6216 | .091 | .6199 | .090 | .6183 | .090 | .6167 | .090 | .6151 | .090 | .6135 | .090 | .6120 | .090 | .6106 | .090 | .6090 | .090 | .6076 | .090 | 1370 |
| .6354 | .090 | .6336 | .089 | .6317 | .089 | .6300 | .089 | .6284 | .089 | .6268 | .089 | .6251 | .089 | .6236 | .089 | .6220 | .089 | .6204 | .089 | .6189 | .089 | .6174 | .089 | .6160 | .089 | 1380 |
| .6436 | .089 | .6418 | .088 | .6400 | .088 | .6383 | .088 | .6366 | .088 | .6350 | .088 | .6334 | .088 | .6317 | .087 | .6301 | .087 | .6286 | .087 | .6271 | .087 | .6256 | .087 | .6242 | .087 | 1390 |
| .6515 | .087 | .6496 | .087 | .6479 | .087 | .6461 | .087 | .6444 | .087 | .6428 | .086 | .6412 | .086 | .6396 | .086 | .6380 | .086 | .6365 | .086 | .6350 | .086 | .6335 | .086 | .6320 | .086 | 1400 |
| .6591 | .086 | .6572 | .086 | .6555 | .086 | .6538 | .086 | .6521 | .086 | .6505 | .086 | .6488 | .086 | .6472 | .085 | .6456 | .085 | .6440 | .085 | .6426 | .085 | .6411 | .085 | .6397 | .085 | 1410 |
| .6663 | .084 | .6645 | .084 | .6628 | .084 | .6611 | .084 | .6593 | .084 | .6577 | .084 | .6561 | .084 | .6545 | .084 | .6529 | .084 | .6514 | .084 | .6499 | .084 | .6485 | .084 | .6470 | .084 | 1420 |
| .6736 | .084 | .6718 | .084 | .6701 | .084 | .6683 | .084 | .6666 | .084 | .6650 | .084 | .6634 | .084 | .6618 | .084 | .6603 | .084 | .6588 | .084 | .6572 | .084 | .6557 | .084 | .6543 | .084 | 1430 |
| .6805 | .082 | .6787 | .082 | .6770 | .082 | .6752 | .082 | .6736 | .082 | .6719 | .082 | .6703 | .082 | .6688 | .082 | .6672 | .082 | .6656 | .082 | .6641 | .082 | .6626 | .082 | .6611 | .082 | 1440 |
| .6872 | .080 | .6854 | .080 | .6836 | .080 | .6820 | .080 | .6803 | .080 | .6787 | .080 | .6771 | .080 | .6754 | .080 | .6738 | .080 | .6723 | .080 | .6708 | .080 | .6693 | .080 | .6679 | .080 | 1450 |
| .6938 | .080 | .6920 | .080 | .6903 | .080 | .6886 | .080 | .6869 | .080 | .6853 | .080 | .6837 | .080 | .6820 | .080 | .6804 | .080 | .6789 | .080 | .6773 | .080 | .6759 | .080 | .6745 | .080 | 1460 |
| .7003 | .078 | .6984 | .078 | .6967 | .078 | .6950 | .078 | .6933 | .078 | .6916 | .078 | .6900 | .078 | .6884 | .078 | .6868 | .078 | .6853 | .078 | .6838 | .078 | .6823 | .078 | .6809 | .078 | 1470 |
| .7063 | .077 | .7045 | .077 | .7028 | .077 | .7010 | .077 | .6994 | .077 | .6978 | .077 | .6962 | .077 | .6946 | .077 | .6930 | .077 | .6914 | .077 | .6899 | .077 | .6884 | .077 | .6870 | .077 | 1480 |
| .7124 | .077 | .7106 | .077 | .7088 | .077 | .7071 | .077 | .7055 | .077 | .7038 | .077 | .7023 | .077 | .7006 | .077 | .6991 | .077 | .6975 | .077 | .6960 | .077 | .6945 | .077 | .6931 | .077 | 1490 |
| .7183 | .076 | .7165 | .076 | .7147 | .076 | .7131 | .076 | .7114 | .076 | .7098 | .076 | .7082 | .076 | .7065 | .076 | .7049 | .076 | .7034 | .076 | .7019 | .076 | .7004 | .076 | .6990 | .076 | 1500 |

Weight in Grams of One Liter of Wet Pulp

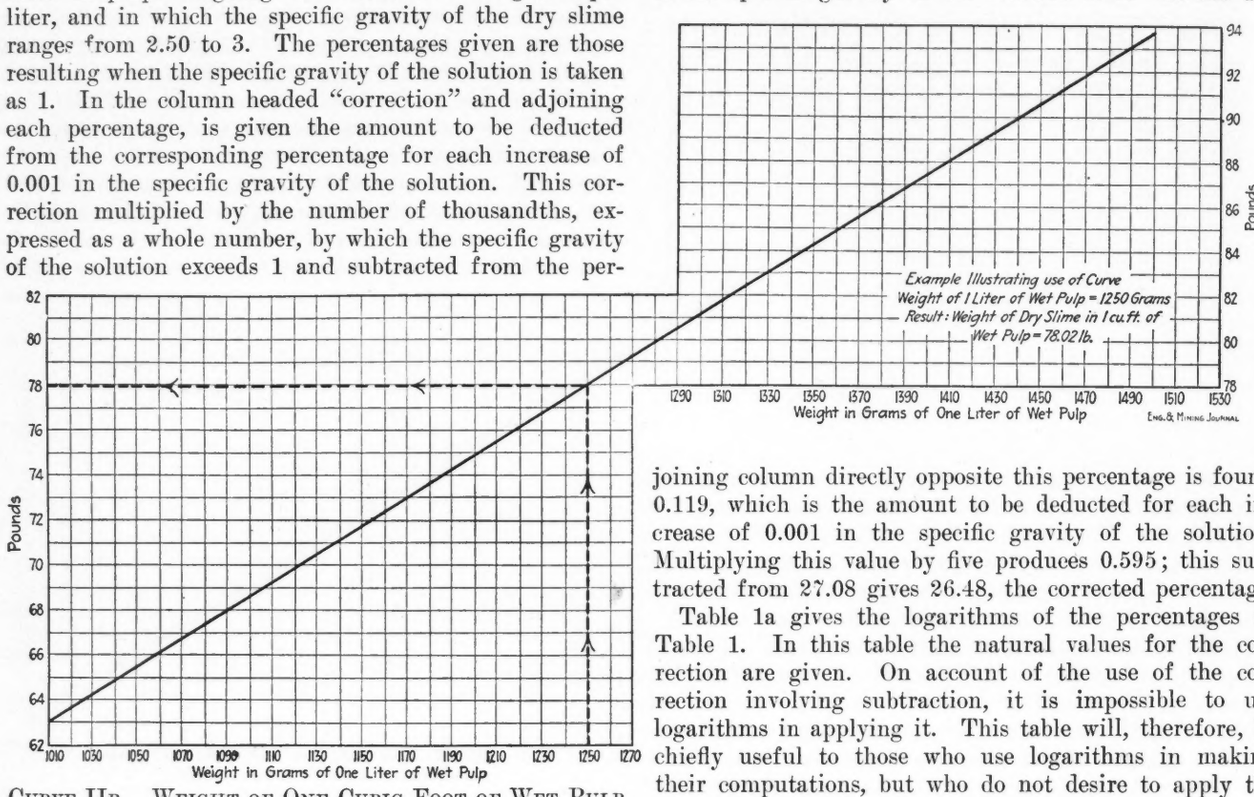
## Use of the Tables

The specific gravity of the dry slime, the specific gravity of the solution and the weight of 1000 c.c. of the pulp having been determined by the methods just described, the necessary data for the use of the first five tables are at hand. The specific gravity of the dry slime may be determined accurately once and need not be again determined unless there is a change in the character of the ore treated; but in order to insure that there has been no change of consequence it is best to repeat this determination occasionally.

In most cases, the specific gravity of the solution will remain more or less constant for some time. Frequent determinations may be made until this point is estab-

lished. It is necessary to determine the weight of 1000 c.c. of the pulp for each individual slime charge.

Table 1 gives the percentage by weight of the dry slime in pulps weighing from 1010 to 1500 grams per liter, and in which the specific gravity of the dry slime ranges from 2.50 to 3. The percentages given are those resulting when the specific gravity of the solution is taken as 1. In the column headed "correction" and adjoining each percentage, is given the amount to be deducted from the corresponding percentage for each increase of 0.001 in the specific gravity of the solution. This correction multiplied by the number of thousandths, expressed as a whole number, by which the specific gravity of the solution exceeds 1 and subtracted from the percentage given in the table, will give the corrected percentage.




CURVE IIB. WEIGHT OF ONE CUBIC FOOT OF WET PULP

This table is generally useful in all plants where wet pulps are handled. It might be mentioned that it would be particularly useful in connection with the control of classifiers. The following example will illustrate the method of using this table:

Given a slime pulp weighing 1200 grams per liter, the specific gravity of the dry slime being 2.60, and the specific gravity of the solution 1.005. At the intersection of the horizontal column headed 1200 (weight of one liter of the wet pulp) and the vertical column headed 2.60 (specific gravity of the dry slime) will be found 27.08, which is the percentage of dry slime in the pulp if the specific gravity of the solution is 1. In the adjoining column directly opposite this percentage is found 0.119, which is the amount to be deducted for each increase of 0.001 in the specific gravity of the solution. Multiplying this value by five produces 0.595; this subtracted from 27.08 gives 26.48, the corrected percentage.

Table 1a gives the logarithms of the percentages in Table 1. In this table the natural values for the correction are given. On account of the use of the correction involving subtraction, it is impossible to use logarithms in applying it. This table will, therefore, be chiefly useful to those who use logarithms in making their computations, but who do not desire to apply the correction for the specific gravity of the solution.

Table 2 gives the weight of one cubic foot of pulp for pulps weighing from 1010 to 1500 grams per liter. Neither the specific gravity of the dry slime nor of the solution need be considered in using this table. This table is chiefly useful in connection with calculating the foundations for tanks which are to contain pulp. Table 2a gives the logarithms of the values contained in Table 2. Curve 2b shows graphically some of the values of Table 2.

Table 3 gives the pounds of dry slime in one cubic foot of pulp for pulps weighing from 1010 to 1500 grams per

TABLE II. WEIGHT IN POUNDS OF ONE CUBIC FOOT OF WET PULP
Formula: 62.42 a
Weight of One Liter of Wet Pulp

| Wt. of One Liter of Wet Pulp | 1010 | 1020 | 1030 | 1040 | 1050 | 1060 | 1070 | 1080 | 1090 | 1100 | 1110 | 1120 | 1130 | 1140 | 1150 | 1160 | 1170 | 1180 | 1190 | 1200 | 1210 | 1220 | 1230 | 1240 | 1250 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wt. of 1 Cu.Ft. of Wet Pulp | 63.04 | 63.66 | 64.28 | 64.91 | 65.54 | 66.16 | 66.79 | 67.41 | 68.03 | 68.66 | 69.28 | 69.90 | 70.53 | 71.16 | 71.78 | 72.41 | 73.03 | 73.65 | 74.27 | 74.90 | 75.53 | 76.15 | 76.77 | 77.39 | 78.02 |

TABLE II. WEIGHT IN POUNDS OF ONE CUBIC FOOT OF WET PULP—Continued

| Wt. of One Liter of Wet Pulp | 1260 | 1270 | 1280 | 1290 | 1300 | 1310 | 1320 | 1330 | 1340 | 1350 | 1360 | 1370 | 1380 | 1390 | 1400 | 1410 | 1420 | 1430 | 1440 | 1450 | 1460 | 1470 | 1480 | 1490 | 1500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wt. of 1 Cu.Ft. of Wet Pulp | 78.65 | 79.27 | 79.89 | 80.52 | 81.14 | 81.77 | 82.39 | 83.02 | 83.64 | 84.26 | 84.88 | 85.51 | 86.14 | 86.76 | 87.38 | 88.00 | 88.63 | 89.25 | 89.88 | 90.51 | 91.13 | 91.35 | 92.38 | 93.00 | 93.63 |

TABLE IIA. LOGARITHMS OF WEIGHT OF ONE CUBIC FOOT OF WET PULP
The Characteristic of All Logarithms in This Table is 1

| Wt. of One Liter of Wet Pulp | 1010 | 1020 | 1030 | 1040 | 1050 | 1060 | 1070 | 1080 | 1090 | 1100 | 1110 | 1120 | 1130 | 1140 | 1150 | 1160 | 1170 | 1180 | 1190 | 1200 | 1210 | 1220 | 1230 | 1240 | 1550 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Logs. of Wt. of One Cu.Ft. Wet Pulp | .7996 | .8039 | .8081 | .8123 | .8165 | .8206 | .8247 | .8287 | .8327 | .8367 | .8406 | .8445 | .8484 | .8522 | .8560 | .8598 | .8635 | .8672 | .8708 | .8743 | .8781 | .8817 | .8852 | .8887 | .8922 |

TABLE IIA. LOGARITHMS OF WEIGHT OF ONE CUBIC FOOT OF WET PULP—Continued

| Wt. of One Liter of Wet Pulp | 1260 | 1270 | 1280 | 1290 | 1300 | 1310 | 1320 | 1330 | 1340 | 1350 | 1360 | 1370 | 1380 | 1390 | 1400 | 1410 | 1420 | 1430 | 1440 | 1450 | 1460 | 1470 | 1480 | 1490 | 1500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Logs. of Wt. of One Cu.Ft. Wet Pulp | .8957 | .8991 | .9025 | .9059 | .9092 | .9126 | .9159 | .9192 | .9224 | .9256 | .9288 | .9320 | .9352 | .9383 | .9414 | .9445 | .9476 | .9506 | .9537 | .9567 | .9597 | .9626 | .9656 | .9685 | .9714 |

liter, and in which the specific gravity of the dry slime ranges from 2.50 to 3. The correction for the specific gravity of the solution is applied in the same manner as in Table 1.

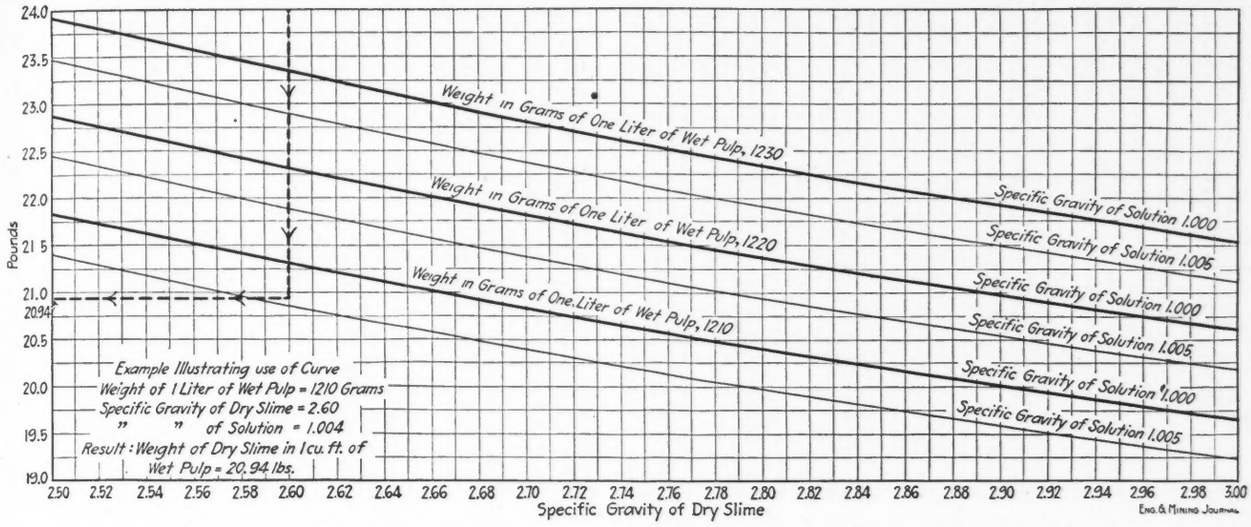
Table 3a gives the logarithms of the values given in Table 3. Natural values are given for the corrections for the reason explained in connection with Table 1a.

Table 4 gives the number of cubic feet of pulp to make one ton of dry slime for pulps weighing from 1010 to 1500 grams per liter, and for specific gravities of dry slime from 2.5 to 3. By reference to the formula from which the values in this table are derived, it will be seen that the correction for the specific gravity of the solution should be added to the values given in the table instead of being subtracted as in Tables 1 and 3.

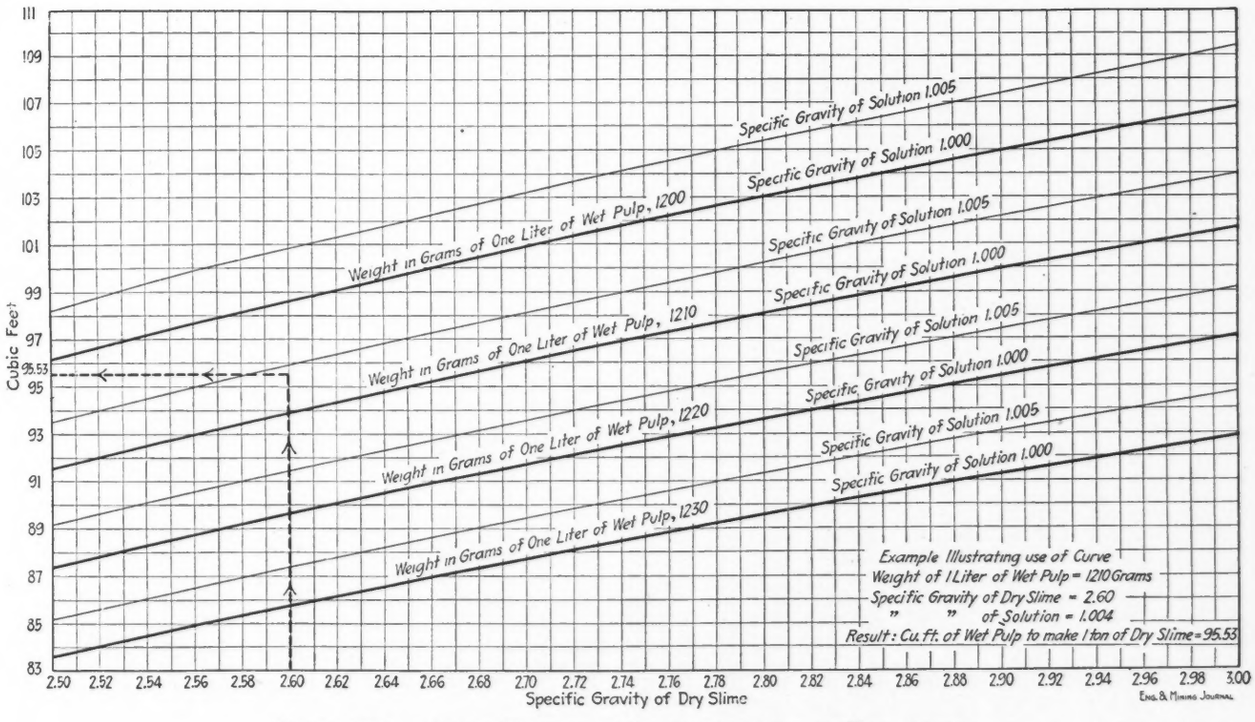
Table 4a gives the logarithms of the values given in Table 4. Natural values are given for the correction for the same reason as in Table 1.

Table 5 gives the dilution (ratio of solution to dry slime) for pulps weighing from 1010 to 1500 grams per liter, and for specific gravities of dry slime from 2.5 to 3. This table is useful in plants where a record is kept of the dilution of each charge.

Table 6 gives the number of cubic feet per foot of depth of circular tanks from 10 to 100 ft. in diameter by steps of one-half inch. Each vertical column in the table is headed by a diameter, given in even feet, which increases by steps by one foot toward the right of the table. Directly beneath each diameter is given the number of cubic feet of capacity per foot




CURVE IIIB. WEIGHTS, IN POUNDS, OF DRY SLIME IN ONE CUBIC FOOT OF WET PULP




CURVE IVB. CUBIC FEET OF PULP TO ONE TON OF DRY SLIME

TABLE III. POUNDS OF DRY SLIME IN ONE CUBIC FOOT OF WET PULP

Formula: $62.42\ a\ \frac{P}{100}$

Specific Gravity of Dry Slime

Weight in Grams of One Liter of Wet Pulp

| | 2.50 | Correction | 2.52 | Correction | 2.54 | Correction | 2.56 | Correction | 2.58 | Correction | 2.60 | Correction | 2.62 | Correction | 2.64 | Correction | 2.66 | Correction | 2.68 | Correction | 2.70 | Correction | 2.72 | Correction | 2.74 | Correction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | 1.040 | | 1.035 | | 1.029 | | 1.024 | | 1.019 | | 1.014 | | 1.009 | | 1.005 | | 1.000 | | .9957 | | .9915 | | .9872 | | .9831 | |
| 1020 | 2.080 | .1033 | 2.070 | .1028 | 2.059 | .1023 | 2.048 | .1017 | 2.038 | .1012 | 2.029 | .1008 | 2.019 | .1003 | 2.010 | .0999 | 2.000 | .0994 | 1.991 | .0989 | 1.983 | .0985 | 1.974 | .0981 | 1.966 | .0977 |
| 1030 | 3.120 | .1026 | 3 104 | .1021 | 3.088 | .1016 | 3.072 | .1011 | 3.057 | .1006 | 3.043 | .1001 | 3.028 | .0996 | 3.014 | .0992 | 3.000 | .0988 | 2.987 | .0984 | 2.974 | .0979 | 2.961 | .0975 | 2.949 | .0971 |
| 1040 | 4.161 | .1020 | 4.140 | .1015 | 4.118 | .1010 | 4.097 | .1005 | 4.077 | .1000 | 4.058 | .0996 | 4 039 | .0992 | 4.020 | .0987 | 4.001 | .0982 | 3.983 | .0978 | 3.966 | .0974 | 3.949 | .0970 | 3.933 | .0966 |
| 1050 | 5.201 | .1012 | 5.175 | .1007 | 5.148 | .1003 | 5.122 | .0998 | 5.097 | .0994 | 5.072 | .0989 | 5 048 | .0984 | 5.025 | .0980 | 5.002 | .0976 | 4.979 | .0972 | 4.957 | .0968 | 4.936 | .0964 | 4.916 | .0960 |
| 1060 | 6.242 | .1006 | 6.210 | .1001 | 6.177 | .0996 | 6.146 | .0991 | 6.116 | .0987 | 6.087 | .0983 | 6.058 | .0979 | 6.030 | .0974 | 6.002 | .0970 | 5.975 | .0967 | 5.950 | .0963 | 5.924 | .0959 | 5.899 | .0955 |
| 1070 | 7.281 | .0998 | 7.244 | .0994 | 7.207 | .0990 | 7.170 | .0985 | 7.134 | .0980 | 7.100 | .0975 | 7.066 | .0971 | 7.034 | .0968 | 7.002 | .0964 | 6.971 | .0961 | 6.941 | .0957 | 6.911 | .0953 | 6.882 | .0948 |
| 1080 | 8.321 | .0991 | 8.279 | .0987 | 8.236 | .0983 | 8.194 | .0978 | 8.154 | .0974 | 8.115 | .0969 | 8.076 | .0965 | 8.039 | .0961 | 8.002 | .0958 | 7.966 | .0955 | 7.932 | .0951 | 7.898 | .0948 | 7.865 | .0944 |
| 1090 | 9.360 | .0983 | 9.312 | .0979 | 9.265 | .0975 | 9.217 | .0970 | 9.171 | .0966 | 9.128 | .0962 | 9.085 | .0959 | 9.043 | .0955 | 9.001 | .0951 | 8.960 | .0947 | 8.923 | .0944 | 8.884 | .0940 | 8.847 | .0936 |
| 1100 | 10.40 | .098 | 10.35 | .098 | 10.29 | .097 | 10.24 | .097 | 10.19 | .096 | 10.14 | .096 | 10.09 | .095 | 10.05 | .095 | 10.00 | .095 | 9.957 | .0944 | 9.915 | .0941 | 9.873 | .0938 | 9.831 | .0934 |
| 1110 | 11.44 | .097 | 11.38 | .096 | 11.32 | .096 | 11.27 | .096 | 11.21 | .095 | 11.16 | .095 | 11.11 | .094 | 11.05 | .094 | 11.00 | .094 | 10.95 | .093 | 10.91 | .093 | 10.86 | .093 | 10.81 | .092 |
| 1120 | 12.48 | .096 | 12.42 | .096 | 12.35 | .095 | 12.29 | .095 | 12.23 | .095 | 12.17 | .094 | 12.11 | .094 | 12.06 | .093 | 12.00 | .093 | 11.95 | .093 | 11.90 | .093 | 11.85 | .093 | 11.80 | .092 |
| 1130 | 13.52 | .095 | 13.45 | .095 | 13.38 | .095 | 13.31 | .094 | 13.25 | .094 | 13.19 | .093 | 13.12 | .093 | 13.06 | .092 | 13.00 | .092 | 12.94 | .092 | 12.89 | .092 | 12.83 | .092 | 12.78 | .091 |
| 1140 | 14.56 | .095 | 14.49 | .095 | 14.41 | .094 | 14.34 | .094 | 14.27 | .094 | 14.20 | .093 | 14.13 | .093 | 14.07 | .092 | 14.00 | .092 | 13.94 | .092 | 13.88 | .091 | 13.82 | .091 | 13.76 | .091 |
| 1150 | 15.60 | .094 | 15.52 | .094 | 15.44 | .094 | 15.36 | .093 | 15.29 | .093 | 15.22 | .092 | 15.14 | .092 | 15.07 | .091 | 15.00 | .091 | 14.93 | .091 | 14.87 | .091 | 14.81 | .091 | 14.75 | .090 |
| 1160 | 16.64 | .093 | 16.56 | .093 | 16.47 | .093 | 16.39 | .092 | 16.30 | .092 | 16.22 | .091 | 16.15 | .091 | 16 08 | .091 | 16.00 | .091 | 15.93 | .091 | 15.86 | .090 | 15.79 | .089 | 15.73 | .089 |
| 1170 | 17.68 | .093 | 17.59 | .092 | 17.50 | .092 | 17.41 | .092 | 17.32 | .091 | 17.24 | .091 | 17.16 | .091 | 17 08 | .090 | 17.00 | .090 | 16.92 | .090 | 16.85 | .090 | 16.78 | .089 | 16.71 | .089 |
| 1180 | 18.72 | .092 | 18.63 | .092 | 18.53 | .092 | 18.44 | .092 | 18.34 | .091 | 18.25 | .091 | 18.17 | .091 | 18 09 | .090 | 18.01 | .090 | 17.93 | .090 | 17.85 | .090 | 17.77 | .089 | 17.70 | .089 |
| 1190 | 19.77 | .092 | 19.67 | .092 | 19.56 | .091 | 19.46 | .091 | 19.36 | .090 | 19.27 | .090 | 19.18 | .090 | 19.09 | .090 | 19.01 | .090 | 18.92 | .089 | 18.84 | .089 | 18.76 | .089 | 18.68 | .089 |
| 1200 | 20.80 | .090 | 20.70 | .090 | 20.59 | .090 | 20.48 | .090 | 20.38 | .089 | 20.29 | .089 | 20 19 | .089 | 20.10 | .088 | 20.00 | .088 | 19.91 | .088 | 19.83 | .088 | 19.74 | .087 | 19.66 | .087 |
| 1210 | 21.84 | .090 | 21.73 | .090 | 21.62 | .090 | 21.51 | .090 | 21.40 | .089 | 21.30 | .089 | 21.20 | .089 | 21.10 | .088 | 21.00 | .088 | 20.91 | .088 | 20.82 | .087 | 20.73 | .087 | 20.64 | .087 |
| 1220 | 22.88 | .089 | 22.77 | .089 | 22.65 | .089 | 22.53 | .089 | 22.42 | .088 | 22.32 | .088 | 22.21 | .088 | 22.11 | .087 | 22.00 | .087 | 21.90 | .087 | 21.81 | .087 | 21.72 | .087 | 21.63 | .087 |
| 1230 | 23.92 | .089 | 23.80 | .089 | 23.68 | .089 | 23.56 | .088 | 23.44 | .088 | 23.33 | .087 | 23.22 | .087 | 23.11 | .087 | 23.00 | .086 | 22.90 | .086 | 22.80 | .086 | 22.70 | .086 | 22.61 | .086 |
| 1240 | 24.96 | .088 | 24.84 | .088 | 24.71 | .088 | 24.58 | .087 | 24.46 | .087 | 24.34 | .087 | 24.23 | .087 | 24.12 | .086 | 24.00 | .086 | 23.89 | .086 | 23.79 | .086 | 23.69 | .086 | 23.59 | .085 |
| 1250 | 26.00 | .087 | 25.87 | .087 | 25.73 | .087 | 25.60 | .087 | 25.47 | .086 | 25.35 | .086 | 25.24 | .086 | 25.12 | .086 | 25.00 | .085 | 24.89 | .085 | 24.79 | .085 | 24.68 | .085 | 24.58 | .085 |
| 1260 | 27.05 | .087 | 26.91 | .087 | 26.77 | .087 | 26.63 | .086 | 26.50 | .086 | 26.38 | .086 | 26.25 | .086 | 26.13 | .086 | 26.01 | .085 | 25.89 | .085 | 25.78 | .085 | 25.67 | .085 | 25.56 | .084 |
| 1270 | 28.09 | .086 | 27.94 | .086 | 27.80 | .086 | 27.66 | .086 | 27.52 | .085 | 27.39 | .085 | 27.26 | .085 | 27.13 | .085 | 27.01 | .085 | 26.89 | .084 | 26.77 | .084 | 26.66 | .084 | 26.55 | .084 |
| 1280 | 29.13 | .085 | 28.98 | .085 | 28.83 | .085 | 28.68 | .084 | 28.54 | .084 | 28.41 | .084 | 28.27 | .084 | 28.14 | .084 | 28.01 | .084 | 27.88 | .083 | 27.76 | .083 | 27.64 | .083 | 27.53 | .083 |
| 1290 | 30.16 | .084 | 30.01 | .084 | 29.85 | .084 | 29.70 | .084 | 29.56 | .083 | 29.42 | .084 | 29.28 | .083 | 29.15 | .083 | 29.01 | .083 | 28.88 | .083 | 28.75 | .083 | 28.63 | .083 | 28.51 | .082 |
| 1300 | 31.20 | .084 | 31.04 | .084 | 30.88 | .084 | 30.72 | .083 | 30.57 | .083 | 30.43 | .083 | 30.28 | .082 | 30.14 | .082 | 30.00 | .082 | 29.87 | .082 | 29.74 | .082 | 29.61 | .082 | 29.49 | .082 |
| 1310 | 32.25 | .083 | 32.08 | .083 | 31.92 | .083 | 31.76 | .083 | 31.60 | .083 | 31.45 | .083 | 31.30 | .082 | 31.15 | .082 | 31.01 | .082 | 30.87 | .082 | 30.74 | .082 | 30.61 | .082 | 30.48 | .082 |
| 1320 | 33.28 | .082 | 33.11 | .082 | 32.94 | .082 | 32.77 | .082 | 32.62 | .082 | 32.46 | .082 | 32.30 | .081 | 32.15 | .081 | 32.00 | .081 | 31.86 | .081 | 31.72 | .081 | 31.59 | .081 | 31.46 | .080 |
| 1330 | 34.32 | .082 | 34.15 | .082 | 33.97 | .082 | 33.80 | .081 | 33.63 | .082 | 33.47 | .081 | 33.31 | .081 | 33.16 | .081 | 33.01 | .081 | 32.86 | .081 | 32.72 | .081 | 32.58 | .081 | 32.44 | .080 |
| 1340 | 35.37 | .082 | 35.19 | .082 | 35.00 | .082 | 34.82 | .081 | 34.65 | .081 | 34.49 | .081 | 34.33 | .081 | 34.17 | .081 | 34.01 | .081 | 33.86 | .081 | 33.71 | .080 | 33.57 | .080 | 33.43 | .080 |
| 1350 | 36.41 | .081 | 36.22 | .081 | 36.03 | .081 | 35.85 | .080 | 35.67 | .080 | 35.50 | .080 | 35.33 | .080 | 35.17 | .080 | 35.01 | .080 | 34.86 | .080 | 34.71 | .080 | 34.56 | .080 | 34.41 | .079 |
| 1360 | 37.45 | .080 | 37.26 | .080 | 37.06 | .080 | 36.87 | .079 | 36.69 | .079 | 36.52 | .079 | 36.34 | .079 | 36.17 | .079 | 36.01 | .079 | 35.85 | .079 | 35.69 | .079 | 35.54 | .079 | 35.39 | .078 |
| 1370 | 38.49 | .079 | 38.29 | .079 | 38.09 | .079 | 37.90 | .079 | 37.71 | .079 | 37.53 | .079 | 37.35 | .079 | 37.18 | .079 | 37.01 | .079 | 36.85 | .079 | 36.69 | .079 | 36.53 | .079 | 36.37 | .078 |
| 1380 | 39.53 | .079 | 39.33 | .079 | 39.12 | .079 | 38.92 | .078 | 38.73 | .078 | 38.55 | .078 | 38.37 | .078 | 38.19 | .078 | 38.01 | .078 | 37.84 | .078 | 37.68 | .078 | 37.52 | .078 | 37.36 | .078 |
| 1390 | 40.57 | .078 | 40.36 | .078 | 40.15 | .078 | 39.95 | .078 | 39.75 | .078 | 39.56 | .078 | 39.37 | .077 | 39.19 | .077 | 39.01 | .077 | 38.84 | .077 | 38.67 | .077 | 38.50 | .077 | 38.34 | .077 |
| 1400 | 41.61 | .077 | 41.40 | .077 | 41.18 | .077 | 40.97 | .077 | 40.77 | .077 | 40.58 | .077 | 40.39 | .077 | 40.20 | .077 | 40.02 | .077 | 39.83 | .076 | 39.66 | .076 | 39.49 | .076 | 39.33 | .076 |
| 1410 | 42.65 | .076 | 42.43 | .076 | 42.21 | .076 | 42.00 | .076 | 41.79 | .076 | 41.59 | .076 | 41.39 | .076 | 41.20 | .076 | 41.01 | .076 | 40.83 | .076 | 40.65 | .076 | 40.48 | .076 | 40.31 | .076 |
| 1420 | 43.69 | .076 | 43.46 | .076 | 43.23 | .076 | 43.01 | .076 | 42.80 | .076 | 42.60 | .075 | 42.40 | .075 | 42.20 | .075 | 42.01 | .075 | 41.82 | .075 | 41.64 | .075 | 41.46 | .075 | 41.28 | .075 |
| 1430 | 44.73 | .076 | 44.50 | .076 | 44.27 | .076 | 44.05 | .075 | 43.83 | .075 | 43.62 | .075 | 43.41 | .075 | 43.21 | .075 | 43.01 | .075 | 42.82 | .075 | 42.63 | .075 | 42.45 | .075 | 42.27 | .074 |
| 1440 | 45.78 | .075 | 45.54 | .075 | 45.30 | .075 | 45.07 | .074 | 44.85 | .074 | 44.63 | .074 | 44.42 | .074 | 44.22 | .074 | 44.02 | .074 | 43.82 | .074 | 43.63 | .074 | 43.44 | .074 | 43.25 | .073 |
| 1450 | 46.81 | .074 | 46.57 | .073 | 46.32 | .073 | 46.09 | .073 | 45.86 | .073 | 45.64 | .073 | 45.43 | .073 | 45.22 | .073 | 45.01 | .073 | 44.81 | .073 | 44.62 | .073 | 44.43 | .073 | 44.24 | .073 |
| 1460 | 47.86 | .073 | 47.61 | .073 | 47.36 | .073 | 47.12 | .073 | 46.89 | .073 | 46.66 | .073 | 46.44 | .073 | 46.22 | .073 | 46.01 | .073 | 45.81 | .073 | 45.61 | .073 | 45.41 | .073 | 45.22 | .073 |
| 1470 | 48.89 | .072 | 48.64 | .072 | 48.39 | .072 | 48.14 | .072 | 47.90 | .072 | 47.67 | .072 | 47.45 | .072 | 47.23 | .072 | 47.01 | .072 | 46.80 | .072 | 46.60 | .072 | 46.40 | .072 | 46.20 | .071 |
| 1480 | 49.93 | .071 | 49.67 | .071 | 49.41 | .071 | 49.16 | .071 | 48.92 | .071 | 48.68 | .071 | 48.45 | .071 | 48.23 | .071 | 48.01 | .071 | 47.79 | .071 | 47.58 | .071 | 47.38 | .071 | 47.18 | .071 |
| 1490 | 50.97 | .071 | 50.71 | .071 | 50.45 | .071 | 50.19 | .071 | 49.94 | .071 | 49.70 | .071 | 49.47 | .071 | 49.24 | .071 | 49.01 | .071 | 48.79 | .071 | 48.58 | .071 | 48.37 | .071 | 48.17 | .071 |
| 1500 | 52.02 | .071 | 51.75 | .071 | 51.48 | .071 | 51.22 | .071 | 50.97 | .071 | 50.72 | .071 | 50.48 | .071 | 50.25 | .071 | 50.02 | .071 | 49.79 | .071 | 49.57 | .071 | 49.36 | .071 | 49.16 | .071 |

TABLE IIIA. LOGARITHMS OF POUNDS OF DRY SLIME IN ONE CUBIC FOOT OF WET PULP

Specific Gravity of Dry Slime

Weight in Grams of One Liter of Wet Pulp

| | 2.50 | Correction | 2.52 | Correction | 2.54 | Correction | 2.56 | Correction | 2.58 | Correction | 2.60 | Correction | 2.62 | Correction | 2.64 | Correction | 2.66 | Correction | 2.68 | Correction | 2.70 | Correction | 2.72 | Correction | 2.74 | Correction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | .0170 | | .0149 | | .0124 | | .0103 | | .0081 | | .0060 | | .0039 | | .0022 | | .0000 | | .9981 | | .9963 | | .9944 | | .9926 | |
| 1020 | .3181 | .1033 | .3160 | .1028 | .3137 | .1023 | .3113 | .1017 | .3092 | .1012 | .3073 | .1008 | .3051 | .1003 | .3032 | .0999 | .3010 | .0994 | .2991 | .0989 | .2973 | .0985 | .2953 | .0981 | .2936 | .0977 |
| 1030 | .4942 | .1026 | .4919 | .1021 | .4897 | .1016 | .4874 | .1011 | .4853 | .1006 | .4833 | .1001 | .4812 | .0996 | .4791 | .0992 | .4771 | .0988 | .4752 | .0984 | .4733 | .0979 | .4714 | .0975 | .4697 | .0971 |
| 1040 | .6192 | .1020 | .6170 | .1015 | .6147 | .1010 | .6125 | .1005 | .6103 | .1000 | .6083 | .0996 | .6063 | .0992 | .6042 | .0987 | .6022 | .0982 | .6002 | .0978 | .5984 | .0974 | .5965 | .0970 | .5947 | .0966 |
| 1050 | .7181 | .1012 | .7139 | .1007 | .7116 | .1003 | .7094 | .0998 | .7073 | .0994 | .7052 | .0989 | .7031 | .0984 | .7011 | .0980 | .6991 | .0976 | .6971 | .0972 | .6952 | .0968 | .6934 | .0964 | .6916 | .0960 |
| 1060 | .7953 | .1006 | .7931 | .1001 | .7908 | .0996 | .7886 | .0991 | .7865 | .0967 | .7844 | .0983 | .7823 | .0979 | .7803 | .0974 | .7783 | .0970 | .7763 | .0967 | .7745 | .0963 | .7726 | .0959 | .7708 | .0955 |
| 1070 | .8622 | .0998 | .8600 | .0994 | .8578 | .0990 | .8553 | .0985 | .8533 | .0980 | .8513 | .0975 | .8492 | .0971 | .8472 | .0968 | .8452 | .0964 | .8433 | .0961 | .8414 | .0957 | .8395 | .0953 | .8377 | .0948 |
| 1080 | .9202 | .0991 | .9180 | .0987 | .9157 | .0983 | .9135 | .0978 | .9114 | .0974 | .9093 | .0969 | .0972 | .0965 | .9052 | .0961 | .9032 | .0958 | .9012 | .0955 | .8994 | .0951 | .8975 | .0948 | .8957 | .0944 |
| 1090 | .9713 | .0983 | .9690 | .0979 | .9669 | .0978 | .9646 | .0970 | .9624 | .0966 | .9604 | .0962 | .9583 | .0959 | .9563 | .0955 | .9543 | .0951 | .9523 | .0947 | .9505 | .0944 | .9486 | .0940 | .9468 | .0936 |
| 1100 | .0170 | .098 | .0149 | .098 | .0124 | .097 | .0103 | .097 | .0081 | .096 | .0060 | .096 | .0039 | .095 | .0022 | .095 | .0000 | .095 | .9981 | .0944 | .9963 | .0941 | .9944 | .0938 | .9926 | .0934 |
| 1110 | .0584 | .097 | .0561 | .096 | .0539 | .096 | .0519 | .096 | .0496 | .095 | .0477 | .095 | .0457 | .094 | .0434 | .094 | .0414 | .094 | .0394 | .093 | .0378 | .093 | .0358 | .093 | .0338 | .092 |
| 1120 | .0962 | .096 | .0941 | .096 | .0917 | .095 | .0896 | .095 | .0874 | .095 | .0853 | .094 | .0831 | .094 | .0813 | .093 | .0792 | .093 | .0774 | .093 | .0755 | .093 | .0737 | .093 | .0719 | .092 |
| 1130 | .1310 | .095 | .1287 | .095 | .1265 | .095 | .1242 | .094 | .1222 | .094 | .1202 | .093 | .1179 | .093 | .1159 | .093 | .1139 | .092 | .1119 | .092 | .1103 | .092 | .1082 | .092 | .1065 | .091 |
| 1140 | .1632 | .095 | .1611 | .095 | .1587 | .094 | .1565 | .094 | .1544 | .094 | .1523 | .093 | .1504 | .093 | .1483 | .092 | .1461 | .092 | .1443 | .092 | .1424 | .091 | .1405 | .091 | .1386 | .091 |
| 1150 | .1931 | .094 | .1909 | .094 | .1886 | .094 | .1864 | .093 | .1844 | .093 | .1824 | .092 | .1801 | .092 | .1781 | .091 | .1761 | .091 | .1741 | .091 | .1723 | .091 | .1706 | .091 | .1688 | .090 |
| 1160 | .2212 | .093 | .2191 | .093 | .2167 | .093 | .2146 | .092 | .2122 | .092 | .2101 | .091 | .2082 | .091 | .2063 | .091 | .2041 | .091 | .2022 | .091 | .2003 | .090 | .1984 | .089 | .1967 | .089 |
| 1170 | .2475 | .093 | .2453 | .092 | .2430 | .092 | .2408 | .092 | .2386 | .091 | .2365 | .091 | .2345 | .091 | .2325 | .090 | .2304 | .090 | .2284 | .089 | .2266 | .089 | .2248 | .089 | .2230 | .089 |
| 1180 | .2723 | .092 | .2702 | .092 | .2679 | .092 | .2658 | .092 | .2634 | .091 | .2613 | .091 | .2594 | .091 | .2574 | .091 | .2555 | .090 | .2536 | .090 | .2516 | .090 | .2497 | .089 | .2480 | .089 |
| 1190 | .2960 | .092 | .2938 | .092 | .2914 | .091 | .2891 | .091 | .2869 | .090 | .2849 | .090 | .2829 | .090 | .2808 | .090 | .2790 | .090 | .2769 | .089 | .2751 | .089 | .2732 | .089 | .2774 | .089 |
| 1200 | .3181 | .090 | .3160 | .090 | .3137 | .090 | .3113 | .090 | .3092 | .089 | .3073 | .089 | .3051 | .089 | .3032 | .088 | .3010 | .088 | .2991 | .088 | .2973 | .088 | .2953 | .087 | .2936 | .087 |
| 1210 | .3393 | .090 | .3371 | .090 | .3349 | .090 | .3326 | .090 | .3304 | .089 | .3284 | .089 | .3263 | .089 | .3243 | .088 | .3222 | .088 | .3204 | .088 | .3185 | .087 | .3166 | .087 | .3147 | .087 |
| 1220 | .3595 | .089 | .3574 | .089 | .3551 | .089 | .3528 | .089 | .3506 | .088 | .3487 | .088 | .3465 | .088 | .3446 | .087 | .3424 | .087 | .3404 | .087 | .3387 | .087 | .3369 | .087 | .3351 | .087 |
| 1230 | .3788 | .089 | .3766 | .089 | .3744 | .089 | .3722 | .088 | .3700 | .088 | .3679 | .087 | .3659 | .087 | .3638 | .087 | .3617 | .086 | .3598 | .086 | .3579 | .086 | .3560 | .086 | .3543 | .086 |
| 1240 | .3972 | .088 | .3952 | .088 | .3929 | .088 | .3906 | .087 | .3885 | .087 | .3865 | .087 | .3845 | .087 | .3824 | .086 | .3802 | .086 | .3782 | .086 | .3764 | .086 | .3746 | .086 | .3727 | .085 |
| 1250 | .4150 | .087 | .4128 | .087 | .4104 | .087 | .4082 | .086 | .4060 | .086 | .4040 | .086 | .4021 | .086 | .4000 | .085 | .3979 | .085 | .3960 | .085 | .3943 | .085 | .3923 | .085 | .3906 | .084 |
| 1260 | .4322 | .087 | .4299 | .087 | .4276 | .087 | .4254 | .087 | .4232 | .086 | .4213 | .086 | .4191 | .086 | .4171 | .086 | .4151 | .086 | .4131 | .085 | .4113 | .085 | .4094 | .085 | .4076 | .085 |
| 1270 | .4486 | .086 | .4462 | .086 | .4440 | .086 | .4419 | .086 | .4396 | .085 | .4376 | .085 | .4355 | .085 | .4334 | .085 | .4315 | .085 | .4296 | .084 | .4276 | .084 | .4259 | .084 | .4241 | .084 |
| 1280 | .4643 | .085 | .4621 | .085 | .4598 | .085 | .4576 | .084 | .4555 | .084 | .4535 | .084 | .4513 | .084 | .4495 | .084 | .4473 | .084 | .4453 | .083 | .4434 | .083 | .4415 | .083 | .4398 | .083 |
| 1290 | .4794 | .084 | .4773 | .084 | .4749 | .084 | .4728 | .083 | .4707 | .083 | .4686 | .083 | .4666 | .083 | .4646 | .083 | .4625 | .083 | .4606 | .083 | .4586 | .083 | .4568 | .083 | .4550 | .082 |
| 1300 | .4942 | .083 | .4919 | .083 | .4897 | .084 | .4874 | .083 | .4853 | .083 | .4833 | .083 | .4812 | .082 | .4791 | .082 | .4771 | .082 | .4752 | .082 | .4733 | .082 | .4714 | .082 | .4697 | .082 |
| 1310 | .5085 | .084 | .5062 | .084 | .5041 | .083 | .5019 | .084 | .4997 | .083 | .4976 | .084 | .4955 | .083 | .4935 | .083 | .4915 | .083 | .4895 | .082 | .4877 | .082 | .4859 | .082 | .4840 | .082 |
| 1320 | .5222 | .082 | .5200 | .082 | .5177 | .082 | .5155 | .081 | .5134 | .081 | .5113 | .081 | .5092 | .081 | .5072 | .081 | .5051 | .081 | .5032 | .081 | .5013 | .081 | .4995 | .081 | .4978 | .080 |
| 1330 | .5355 | .082 | .5334 | .082 | .5311 | .082 | .5289 | .082 | .5267 | .082 | .5247 | .082 | .5226 | .081 | .5206 | .081 | .5186 | .081 | .5167 | .081 | .5148 | .081 | .5130 | .081 | .5111 | .080 |
| 1340 | .5486 | .082 | .5464 | .082 | .5441 | .082 | .5419 | .081 | .5397 | .081 | .5377 | .081 | .5357 | .081 | .5336 | .081 | .5316 | .081 | .5297 | .081 | .5278 | .080 | .5260 | .080 | .5241 | .080 |
| 1350 | .5612 | .081 | .5590 | .081 | .5567 | .081 | .5545 | .080 | .5523 | .080 | .5502 | .080 | .5481 | .080 | .5462 | .080 | .5442 | .080 | .5423 | .080 | .5404 | .080 | .5386 | .080 | .5367 | .079 |
| 1360 | .5734 | .080 | .5712 | .080 | .5689 | .080 | .5667 | .079 | .5645 | .079 | .5625 | .079 | .5604 | .079 | .5583 | .079 | .5564 | .079 | .5545 | .079 | .5525 | .079 | .5507 | .079 | .5489 | .078 |
| 1370 | .5853 | .079 | .5831 | .079 | .5808 | .079 | .5786 | .079 | .5765 | .079 | .5744 | .079 | .5723 | .079 | .5703 | .079 | .5683 | .079 | .5664 | .079 | .5645 | .079 | .5626 | .079 | .5607 | .078 |
| 1380 | .5969 | .079 | .5947 | .079 | .5924 | .079 | .5902 | .078 | .5880 | .078 | .5860 | .078 | .5840 | .078 | .5819 | .078 | .5799 | .078 | .5780 | .078 | .5761 | .078 | .5742 | .078 | .5724 | .078 |
| 1390 | .6082 | .078 | .6060 | .078 | .6037 | .078 | .6015 | .078 | .5993 | .078 | .5973 | .078 | .5952 | .077 | .5932 | .077 | .5912 | .077 | .5893 | .077 | .5874 | .077 | .5855 | .077 | .5837 | .077 |
| 1400 | .6192 | .077 | .6170 | .077 | .6147 | .077 | .6125 | .077 | .6103 | .077 | .6083 | .077 | .6063 | .077 | .6042 | .077 | .6022 | .077 | .6002 | .076 | .5984 | .076 | .5965 | .076 | .5947 | .076 |
| 1410 | .6299 | .076 | .6277 | .076 | .6254 | .076 | .6232 | .076 | .6211 | .076 | .6190 | .076 | .6169 | .076 | .6149 | .076 | .6129 | .076 | .6110 | .076 | .6091 | .076 | .6072 | .076 | .6054 | .076 |
| 1420 | .6404 | .076 | .6381 | .076 | .6358 | .076 | .6336 | .075 | .6314 | .075 | .6294 | .075 | .6274 | .075 | .6253 | .075 | .6234 | .075 | .6214 | .075 | .6195 | .075 | .6176 | .075 | .6157 | .074 |
| 1430 | .6506 | .076 | .6484 | .076 | .6461 | .076 | .6439 | .076 | .6418 | .076 | .6397 | .076 | .6376 | .075 | .6356 | .075 | .6336 | .075 | .6316 | .075 | .6297 | .075 | .6279 | .075 | .6260 | .075 |
| 1440 | .6607 | .075 | .6584 | .075 | .6561 | .075 | .6539 | .074 | .6518 | .074 | .6496 | .074 | .6476 | .074 | .6456 | .074 | .6436 | .074 | .6417 | .074 | .6398 | .074 | .6379 | .074 | .6360 | .073 |
| 1450 | .6703 | .073 | .6681 | .073 | .6658 | .073 | .6636 | .073 | .6614 | .073 | .6593 | .073 | .6573 | .073 | .6553 | .073 | .6533 | .073 | .6514 | .073 | .6495 | .073 | .6477 | .073 | .6458 | .073 |
| 1460 | .6800 | .074 | .6777 | .073 | .6754 | .073 | .6732 | .073 | .6711 | .073 | .6689 | .073 | .6663 | .073 | .6648 | .073 | .6628 | .073 | .6610 | .073 | .6591 | .073 | .6572 | .073 | .6553 | .073 |
| 1470 | .6892 | .072 | .6870 | .072 | .6848 | .072 | .6825 | .072 | .6803 | .072 | .6782 | .072 | .6762 | .072 | .6742 | .072 | .6722 | .072 | .6702 | .072 | .6684 | .072 | .6665 | .072 | .6646 | .071 |
| 1480 | .6984 | .071 | .6961 | .071 | .6938 | .071 | .6916 | .071 | .6895 | .071 | .6874 | .071 | .6853 | .071 | .6833 | .071 | .6813 | .071 | .6793 | .071 | .6774 | .071 | .6757 | .071 | .6738 | .071 |
| 1490 | .7073 | .071 | .7050 | .071 | .7029 | .071 | .7006 | .071 | .6984 | .071 | .6964 | .071 | .6943 | .071 | .6923 | .071 | .6903 | .071 | .6883 | .071 | .6865 | .071 | .6846 | .071 | .6828 | .071 |
| 1500 | .7162 | .071 | .7139 | .071 | .7116 | .071 | .7084 | .071 | .7073 | .071 | .7052 | .071 | .7031 | .071 | .7011 | .071 | .6991 | .071 | .6971 | .071 | .6952 | .071 | .6934 | .071 | .6916 | .071 |

Note—The natural values are given for the corrections on account of the manner in which they are applied.

of depth for a circular tank of this particular diameter. Reading downward in the table, capacities in cubic feet per foot of depth are given for each increase of ½ in. in diameter. Cubic feet of capacity for one foot of depth, multiplied by the depth of the pulp in the tank, will give the number of cubic feet of content.

### Measurements and Example of Use of Tables

Sharwood[28] calls attention to the variations which may exist in the diameter of wooden tanks. Differences of 6

[28] "Measurement of Pulp and Tailing," "Min. Mag.," Vol. 1, p. 228.

NOTE—The characteristics of the logarithms in the above table can be determined as was done in Table 1. They are all either 0 or 1. See footnote on p. 1084.

TABLE III. POUNDS OF DRY SLIME IN ONE CUBIC FOOT OF WET PULP—Continued

Formula: $62.42\ a\ \frac{P}{100}$

Specific Gravity of Dry Slime

| 2.76 | Correction | 2.78 | Correction | 2.80 | Correction | 2.82 | Correction | 2.84 | Correction | 2.86 | Correction | 2.88 | Correction | 2.90 | Correction | 2.92 | Correction | 2.94 | Correction | 2.96 | Correction | 2.98 | Correction | 3.00 | Correction | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .9789 | | .9748 | | .9700 | | .9670 | | .9633 | | .9598 | | .9561 | | .9526 | | .9493 | | .9458 | | .9425 | | .9393 | | .9363 | | 1010 |
| 1.958 | .0973 | 1.950 | .0970 | 1.942 | .0966 | 1.934 | .0962 | 1.927 | .0958 | 1.920 | .0955 | 1.912 | .0951 | 1.905 | .0947 | 1.898 | .0944 | 1.891 | .0940 | 1.885 | .0937 | 1.878 | .0934 | 1.872 | .0931 | 1020 |
| 2.936 | .0967 | 2.924 | .0963 | 2.913 | .0960 | 2.901 | .0957 | 2.890 | .0953 | 2.879 | .0949 | 2.868 | .0946 | 2.858 | .0943 | 2.848 | .0939 | 2.837 | .0936 | 2.827 | .0933 | 2.818 | .0930 | 2.809 | .0927 | 1030 |
| 3.916 | .0963 | 3.900 | .0959 | 3.884 | .0955 | 3.869 | .0952 | 3.854 | .0949 | 3.840 | .0945 | 3.825 | .0941 | 3.811 | .0938 | 3.797 | .0935 | 3.784 | .0932 | 3.771 | .0929 | 3.758 | .0926 | 3.745 | .0923 | 1040 |
| 4.895 | .0956 | 4.874 | .0952 | 4.854 | .0948 | 4.835 | .0945 | 4.817 | .0942 | 4.799 | .0939 | 4.781 | .0935 | 4.763 | .0932 | 4.746 | .0929 | 4.729 | .0926 | 4.713 | .0923 | 4.697 | .0920 | 4.682 | .0918 | 1050 |
| 5.873 | .0951 | 5.849 | .0947 | 5.826 | .0944 | 5.803 | .0941 | 5.781 | .0938 | 5.759 | .0934 | 5.737 | .0931 | 5.716 | .0928 | 5.696 | .0925 | 5.676 | .0922 | 5.656 | .0919 | 5.637 | .0916 | 5.618 | .0914 | 1060 |
| 6.852 | .0944 | 6.823 | .0940 | 6.796 | .0937 | 6.769 | .0934 | 6.744 | .0931 | 6.719 | .0928 | 6.693 | .0925 | 6.668 | .0922 | 6.644 | .0919 | 6.621 | .0916 | 6.598 | .0913 | 6.575 | .0910 | 6.554 | .0908 | 1070 |
| 7.831 | .0940 | 7.798 | .0936 | 7.767 | .0933 | 7.736 | .0930 | 7.707 | .0927 | 7.678 | .0923 | 7.649 | .0920 | 7.621 | .0918 | 7.594 | .0915 | 7.567 | .0913 | 7.541 | .0910 | 7.515 | .0907 | 7.490 | .0904 | 1080 |
| 8.808 | .0932 | 8.772 | .0929 | 8.738 | .0927 | 8.702 | .0924 | 8.669 | .0921 | 8.637 | .0917 | 8.604 | .0914 | 8.572 | .0911 | 8.542 | .0909 | 8.512 | .0906 | 8.482 | .0903 | 8.453 | .0901 | 8.426 | .0899 | 1090 |
| 9.789 | .0930 | 9.748 | .0926 | 9.709 | .0923 | 9.670 | .0920 | 9.633 | .0917 | 9.597 | .0913 | 9.561 | .0910 | 9.526 | .0908 | 9.492 | .0905 | 9.458 | .0903 | 9.425 | .0900 | 9.393 | .0898 | 9.363 | .0896 | 1100 |
| 10.77 | .092 | 10.72 | .092 | 10.68 | .092 | 10.64 | .092 | 10.60 | .091 | 10.56 | .091 | 10.52 | .091 | 10.48 | .090 | 10.44 | .090 | 10.40 | .089 | 10.37 | .089 | 10.33 | .089 | 10.30 | .089 | 1110 |
| 11.75 | .092 | 11.70 | .091 | 11.65 | .091 | 11.60 | .091 | 11.56 | .091 | 11.52 | .091 | 11.47 | .090 | 11.43 | .090 | 11.39 | .090 | 11.35 | .089 | 11.31 | .089 | 11.27 | .089 | 11.24 | .089 | 1120 |
| 12.72 | .091 | 12.67 | .091 | 12.62 | .090 | 12.57 | .090 | 12.52 | .090 | 12.48 | .090 | 12.43 | .089 | 12.38 | .089 | 12.34 | .089 | 12.29 | .088 | 12.25 | .088 | 12.21 | .088 | 12.17 | .088 | 1130 |
| 13.70 | .090 | 13.65 | .090 | 13.59 | .090 | 13.54 | .090 | 13.49 | .090 | 13.44 | .090 | 13.39 | .089 | 13.34 | .089 | 13.29 | .089 | 13.24 | .088 | 13.20 | .088 | 13.15 | .088 | 13.11 | .088 | 1140 |
| 14.68 | .090 | 14.62 | .090 | 14.56 | .089 | 14.50 | .089 | 14.45 | .089 | 14.40 | .089 | 14.34 | .088 | 14.29 | .088 | 14.24 | .088 | 14.19 | .088 | 14.14 | .087 | 14.09 | .087 | 14.04 | .087 | 1150 |
| 15.66 | .089 | 15.60 | .088 | 15.53 | .088 | 15.47 | .088 | 15.41 | .088 | 15.36 | .088 | 15.30 | .088 | 15.24 | .088 | 15.19 | .087 | 15.13 | .087 | 15.08 | .087 | 15.03 | .087 | 14.98 | .087 | 1160 |
| 16.64 | .089 | 16.57 | .088 | 16.50 | .088 | 16.44 | .088 | 16.38 | .088 | 16.31 | .087 | 16.25 | .087 | 16.19 | .087 | 16.14 | .087 | 16.08 | .087 | 16.02 | .086 | 15.97 | .086 | 15.91 | .086 | 1170 |
| 17.62 | .089 | 17.55 | .088 | 17.48 | .088 | 17.41 | .088 | 17.34 | .088 | 17.28 | .087 | 17.21 | .087 | 17.15 | .087 | 17.09 | .087 | 17.03 | .087 | 16.97 | .086 | 16.91 | .086 | 16.85 | .086 | 1180 |
| 18.60 | .088 | 18.52 | .088 | 18.45 | .088 | 18.38 | .088 | 18.31 | .088 | 18.24 | .087 | 18.17 | .087 | 18.10 | .086 | 18.04 | .086 | 17.97 | .086 | 17.91 | .086 | 17.85 | .086 | 17.79 | .085 | 1190 |
| 19.58 | .087 | 19.50 | .087 | 19.42 | .087 | 19.34 | .087 | 19.27 | .087 | 19.20 | .086 | 19.12 | .086 | 19.05 | .085 | 18.98 | .085 | 18.91 | .085 | 18.85 | .084 | 18.78 | .084 | 18.72 | .084 | 1200 |
| 20.55 | .086 | 20.47 | .086 | 20.39 | .086 | 20.31 | .086 | 20.23 | .086 | 20.16 | .086 | 20.08 | .085 | 20.00 | .085 | 19.93 | .085 | 19.86 | .085 | 19.79 | .084 | 19.72 | .084 | 19.66 | .084 | 1210 |
| 21.53 | .086 | 21.44 | .086 | 21.36 | .086 | 21.27 | .086 | 21.19 | .086 | 21.12 | .086 | 21.04 | .085 | 20.96 | .085 | 20.88 | .085 | 20.81 | .085 | 20.73 | .084 | 20.66 | .084 | 20.60 | .084 | 1220 |
| 22.51 | .085 | 22.42 | .085 | 22.33 | .085 | 22.24 | .085 | 22.16 | .085 | 22.08 | .085 | 21.99 | .084 | 21.91 | .084 | 21.83 | .084 | 21.75 | .084 | 21.68 | .083 | 21.60 | .083 | 21.53 | .083 | 1230 |
| 23.49 | .085 | 23.39 | .085 | 23.30 | .085 | 23.21 | .085 | 23.12 | .085 | 23.04 | .085 | 22.95 | .084 | 22.86 | .084 | 22.78 | .084 | 22.70 | .084 | 22.62 | .083 | 22.54 | .083 | 22.47 | .083 | 1240 |
| 24.47 | .084 | 24.37 | .084 | 24.27 | .084 | 24.17 | .084 | 24.08 | .084 | 23.99 | .084 | 23.90 | .083 | 23.81 | .083 | 23.73 | .083 | 23.64 | .083 | 23.56 | .082 | 23.48 | .082 | 23.40 | .082 | 1250 |
| 25.45 | .084 | 25.35 | .084 | 25.25 | .084 | 25.15 | .084 | 25.05 | .084 | 24.96 | .084 | 24.86 | .083 | 24.77 | .083 | 24.68 | .083 | 24.60 | .083 | 24.51 | .082 | 24.42 | .082 | 24.34 | .082 | 1260 |
| 26.43 | .084 | 26.32 | .083 | 26.22 | .083 | 26.11 | .083 | 26.01 | .083 | 25.92 | .083 | 25.82 | .083 | 25.72 | .082 | 25.63 | .082 | 25.54 | .082 | 25.45 | .082 | 25.36 | .082 | 25.28 | .082 | 1270 |
| 27.41 | .083 | 27.30 | .083 | 27.19 | .083 | 27.08 | .083 | 26.98 | .083 | 26.88 | .082 | 26.77 | .082 | 26.67 | .082 | 26.58 | .081 | 26.49 | .081 | 26.39 | .081 | 26.30 | .081 | 26.22 | .081 | 1280 |
| 28.39 | .082 | 28.27 | .082 | 28.16 | .082 | 28.05 | .082 | 27.94 | .082 | 27.84 | .082 | 27.73 | .082 | 27.63 | .082 | 27.53 | .081 | 27.43 | .081 | 27.33 | .081 | 27.24 | .080 | 27.15 | .080 | 1290 |
| 29.36 | .082 | 29.24 | .082 | 29.13 | .082 | 29.01 | .082 | 28.90 | .082 | 28.79 | .081 | 28.68 | .081 | 28.58 | .081 | 28.48 | .080 | 28.37 | .080 | 28.27 | .080 | 28.18 | .080 | 28.09 | .080 | 1300 |
| 30.35 | .082 | 30.22 | .082 | 30.10 | .081 | 29.98 | .081 | 29.87 | .081 | 29.76 | .081 | 29.64 | .081 | 29.53 | .081 | 29.43 | .080 | 29.32 | .080 | 29.22 | .080 | 29.12 | .080 | 29.03 | .080 | 1310 |
| 31.32 | .080 | 31.19 | .080 | 31.07 | .080 | 30.94 | .080 | 30.82 | .080 | 30.71 | .080 | 30.59 | .080 | 30.48 | .080 | 30.37 | .079 | 30.26 | .079 | 30.16 | .079 | 30.06 | .079 | 29.96 | .079 | 1320 |
| 32.30 | .080 | 32.17 | .080 | 32.04 | .080 | 31.91 | .080 | 31.79 | .080 | 31.67 | .080 | 31.55 | .080 | 31.43 | .080 | 31.32 | .079 | 31.21 | .079 | 31.10 | .079 | 31.00 | .079 | 30.90 | .079 | 1330 |
| 33.28 | .080 | 33.14 | .080 | 33.01 | .079 | 32.88 | .079 | 32.76 | .079 | 32.63 | .079 | 32.51 | .079 | 32.39 | .079 | 32.28 | .079 | 32.16 | .079 | 32.05 | .079 | 31.94 | .079 | 31.83 | .079 | 1340 |
| 34.26 | .079 | 34.12 | .079 | 33.99 | .079 | 33.85 | .079 | 33.72 | .079 | 33.60 | .079 | 33.47 | .079 | 33.35 | .079 | 33.23 | .078 | 33.11 | .078 | 32.99 | .078 | 32.88 | .078 | 32.77 | .078 | 1350 |
| 35.24 | .078 | 35.09 | .078 | 34.95 | .078 | 34.81 | .078 | 34.68 | .078 | 34.55 | .077 | 34.42 | .077 | 34.29 | .077 | 34.17 | .077 | 34.05 | .077 | 33.93 | .077 | 33.81 | .077 | 33.70 | .077 | 1360 |
| 36.22 | .078 | 36.07 | .078 | 35.92 | .077 | 35.78 | .077 | 35.64 | .077 | 35.51 | .077 | 35.38 | .077 | 35.25 | .077 | 35.12 | .077 | 34.99 | .077 | 34.87 | .077 | 34.75 | .076 | 34.64 | .076 | 1370 |
| 37.20 | .078 | 37.05 | .078 | 36.90 | .077 | 36.75 | .077 | 36.61 | .077 | 36.47 | .077 | 36.33 | .077 | 36.20 | .077 | 36.07 | .077 | 35.94 | .077 | 35.82 | .077 | 35.70 | .076 | 35.58 | .076 | 1380 |
| 38.18 | .077 | 38.02 | .077 | 37.87 | .077 | 37.72 | .077 | 37.58 | .077 | 37.44 | .077 | 37.29 | .077 | 37.15 | .077 | 37.02 | .076 | 36.89 | .076 | 36.76 | .076 | 36.64 | .076 | 36.52 | .076 | 1390 |
| 39.16 | .076 | 39.00 | .076 | 38.84 | .076 | 38.69 | .076 | 38.54 | .076 | 38.40 | .076 | 38.25 | .076 | 38.11 | .076 | 37.97 | .075 | 37.84 | .075 | 37.71 | .075 | 37.58 | .075 | 37.45 | .075 | 1400 |
| 40.14 | .076 | 39.97 | .076 | 39.81 | .075 | 39.65 | .075 | 39.50 | .075 | 39.35 | .075 | 39.20 | .075 | 39.06 | .075 | 38.92 | .075 | 38.78 | .075 | 38.65 | .075 | 38.52 | .075 | 38.39 | .075 | 1410 |
| 41.11 | .075 | 40.94 | .075 | 40.78 | .074 | 40.62 | .074 | 40.46 | .074 | 40.30 | .075 | 40.15 | .075 | 40.00 | .075 | 39.86 | .074 | 39.72 | .074 | 39.58 | .074 | 39.45 | .074 | 39.32 | .074 | 1420 |
| 42.09 | .075 | 41.92 | .075 | 41.75 | .074 | 41.58 | .074 | 41.43 | .074 | 41.28 | .075 | 41.12 | .075 | 40.97 | .075 | 40.82 | .074 | 40.67 | .074 | 40.53 | .074 | 40.39 | .074 | 40.26 | .074 | 1430 |
| 43.07 | .073 | 42.89 | .073 | 42.72 | .073 | 42.55 | .073 | 42.39 | .073 | 42.23 | .073 | 42.07 | .073 | 41.92 | .073 | 41.77 | .073 | 41.62 | .073 | 41.47 | .073 | 41.33 | .073 | 41.20 | .073 | 1440 |
| 44.05 | .073 | 43.87 | .073 | 43.69 | .073 | 43.52 | .073 | 43.35 | .073 | 43.18 | .073 | 43.03 | .072 | 42.87 | .072 | 42.71 | .072 | 42.56 | .072 | 42.41 | .072 | 42.37 | .072 | 42.13 | .072 | 1450 |
| 45.03 | .073 | 44.84 | .073 | 44.66 | .073 | 44.49 | .073 | 44.32 | .073 | 44.15 | .073 | 43.99 | .072 | 43.83 | .072 | 43.67 | .072 | 43.51 | .072 | 43.36 | .072 | 43.21 | .072 | 43.07 | .072 | 1460 |
| 46.00 | .071 | 45.81 | .071 | 45.63 | .071 | 45.45 | .071 | 45.28 | .071 | 45.11 | .071 | 44.94 | .071 | 44.78 | .071 | 44.62 | .071 | 44.46 | .071 | 44.30 | .071 | 44.15 | .071 | 44.00 | .071 | 1470 |
| 46.98 | .071 | 46.79 | .071 | 46.60 | .071 | 46.42 | .071 | 46.24 | .071 | 46.06 | .071 | 45.89 | .071 | 45.72 | .071 | 45.56 | .071 | 45.40 | .071 | 45.24 | .071 | 45.08 | .071 | 44.93 | .071 | 1480 |
| 47.96 | .071 | 47.76 | .071 | 47.57 | .071 | 47.39 | .071 | 47.21 | .071 | 47.03 | .071 | 46.85 | .071 | 46.68 | .071 | 46.51 | .071 | 46.35 | .071 | 46.19 | .071 | 46.03 | .071 | 45.88 | .071 | 1490 |
| 48.95 | .071 | 48.74 | .071 | 48.54 | .071 | 48.35 | .071 | 48.17 | .071 | 47.99 | .071 | 47.81 | .071 | 47.63 | .071 | 47.46 | .071 | 47.29 | .071 | 47.13 | .071 | 46.97 | .071 | 46.81 | .071 | 1500 |

Weight in Grams of One Liter of Wet Pulp

TABLE III-A. LOGARITHMS OF POUNDS OF DRY SLIME IN ONE CUBIC FOOT OF WET PULP—Continued

Specific Gravity of Dry Slime

| 2.76 | Correction | 2.78 | Correction | 2.80 | Correction | 2.82 | Correction | 2.84 | Correction | 2.86 | Correction | 2.88 | Correction | 2.90 | Correction | 2.92 | Correction | 2.94 | Correction | 2.96 | Correction | 2.98 | Correction | 3.00 | Correction | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .9907 | | .9889 | | .9872 | | .9854 | | .9838 | | .9822 | | .9805 | | .9789 | | .9774 | | .9758 | | .9743 | | .9728 | | .9714 | | 1010 |
| .2918 | .0973 | .2900 | .0970 | .2882 | .0966 | .2865 | .0962 | .2849 | .0958 | .2833 | .0955 | .2815 | .0951 | .2799 | .0947 | .2783 | .0944 | .2767 | .0940 | .2753 | .0937 | .2737 | .0934 | .2723 | .0931 | 1020 |
| .4678 | .0967 | .4660 | .0963 | .4643 | .0960 | .4625 | .0957 | .4609 | .0953 | .4592 | .0949 | .4576 | .0946 | .4561 | .0943 | .4545 | .0939 | .4529 | .0936 | .4513 | .0933 | .4499 | .0933 | .4486 | .0927 | 1030 |
| .5928 | .0963 | .5911 | .0959 | .5893 | .0955 | .5876 | .0952 | .5859 | .0949 | .5843 | .0945 | .5826 | .0941 | .5810 | .0938 | .5794 | .0935 | .5780 | .0932 | .5765 | .0929 | .5750 | .0926 | .5735 | .0923 | 1040 |
| .6898 | .6956 | .6879 | .0952 | .6861 | .0948 | .6844 | .0945 | .6828 | .0942 | .6812 | .0939 | .6795 | .0935 | .6779 | .0932 | .6763 | .0929 | .6748 | .0926 | .6733 | .0923 | .6718 | .0920 | .6704 | .0918 | 1050 |
| .7689 | .0951 | .7671 | .0947 | .7654 | .0944 | .7637 | .0941 | .7620 | .0938 | .7604 | .0934 | .7587 | .0931 | .7671 | .0928 | .7556 | .0925 | .7540 | .0922 | .7525 | .0919 | .7510 | .0916 | .7496 | .0914 | 1060 |
| .8354 | .0944 | .8340 | .0940 | .8323 | .0937 | .8305 | .0934 | .8289 | .0931 | .8273 | .0928 | .8256 | .0925 | .8240 | .0922 | .8224 | .0919 | .8209 | .0916 | .8194 | .0913 | .8179 | .0910 | .8165 | .0908 | 1070 |
| .8938 | .0940 | .8920 | .0936 | .8903 | .0933 | .8885 | .0930 | .8869 | .0927 | .8852 | .0923 | .8836 | .0920 | .8820 | .0918 | .8805 | .0915 | .8789 | .0913 | .8774 | .0910 | .8759 | .0907 | .8745 | .0904 | 1080 |
| .9449 | .0932 | .9431 | .0929 | .9414 | .0927 | .9396 | .0924 | .9380 | .0921 | .9364 | .0917 | .9347 | .0914 | .9031 | .0911 | .9316 | .0909 | .9300 | .0906 | .9285 | .0903 | .9270 | .0901 | .9256 | .0899 | 1090 |
| .9907 | .0930 | .9889 | .0926 | .9872 | .0923 | .9854 | .0920 | .9838 | .0917 | .9821 | .0913 | .9805 | .0910 | .9789 | .0908 | .9774 | .0905 | .9758 | .0903 | .9743 | .0900 | .9728 | .0898 | .9714 | .0899 | 1100 |
| .0322 | .092 | .0302 | .092 | .0286 | .092 | .0269 | .092 | .0253 | .091 | .0237 | .091 | .0220 | .091 | .0204 | .090 | .0187 | .089 | .0170 | .089 | .0158 | .089 | .0141 | .089 | .0128 | .089 | 1110 |
| .0700 | .092 | .0682 | .091 | .0663 | .091 | .0645 | .092 | .0630 | .091 | .0614 | .091 | .0596 | .090 | .0580 | .090 | .0565 | .090 | .0545 | .089 | .0535 | .089 | .0159 | .089 | .0508 | .089 | 1120 |
| .1045 | .091 | .1028 | .091 | .1017 | .090 | .0993 | .090 | .0976 | .090 | .0962 | .090 | .0945 | .089 | .0927 | .089 | .0913 | .089 | .0896 | .088 | .0881 | .088 | .0867 | .088 | .0853 | .088 | 1130 |
| .1367 | .090 | .1351 | .090 | .1332 | .090 | .1316 | .090 | .1300 | .090 | .1284 | .090 | .1268 | .090 | .1252 | .089 | .1235 | .089 | .1219 | .088 | .1206 | .088 | .1189 | .088 | .1176 | .088 | 1140 |
| .1667 | .090 | .1649 | .090 | .1632 | .089 | .1614 | .089 | .1599 | .089 | .1524 | .089 | .1566 | .088 | .1550 | .088 | .1535 | .088 | .1520 | .088 | .1504 | .087 | .1489 | .087 | .1474 | .087 | 1150 |
| .1948 | .089 | .1931 | .088 | .1912 | .088 | .1895 | .088 | .1878 | .088 | .1864 | .088 | .1847 | .088 | .1830 | .088 | .1816 | .087 | .1798 | .087 | .1784 | .087 | .1770 | .087 | .1755 | .087 | 1160 |
| .2212 | .089 | .2193 | .089 | .2179 | .088 | .2159 | .088 | .2145 | .088 | .2125 | .087 | .2109 | .087 | .2092 | .087 | .2079 | .087 | .2063 | .087 | .2047 | .086 | .2033 | .086 | .2017 | .086 | 1170 |
| .2460 | .089 | .2443 | .088 | .2425 | .088 | .2408 | .088 | .2391 | .088 | .2375 | .088 | .2358 | .087 | .2343 | .087 | .2327 | .087 | .2312 | .087 | .2297 | .086 | .2281 | .086 | .2266 | .086 | 1180 |
| .2695 | .088 | .2676 | .088 | .2660 | .088 | .2643 | .088 | .2627 | .088 | .2610 | .087 | .2594 | .087 | .2577 | .086 | .2562 | .086 | .2545 | .086 | .2531 | .086 | .2516 | .086 | .2502 | .085 | 1190 |
| .2918 | .087 | .2908 | .087 | .2882 | .087 | .2865 | .087 | .2849 | .087 | .2833 | .086 | .2815 | .086 | .2799 | .085 | .2783 | .085 | .2767 | .085 | .2753 | .084 | .2737 | .084 | .2723 | .084 | 1200 |
| .3128 | .086 | .3111 | .086 | .3094 | .086 | .3077 | .086 | .3060 | .086 | .3045 | .086 | .3028 | .085 | .3010 | .085 | .2995 | .085 | .2980 | .085 | .2963 | .084 | .2949 | .084 | .2936 | .084 | 1210 |
| .3330 | .086 | .3312 | .086 | .3296 | .086 | .3278 | .086 | .3261 | .086 | .3247 | .086 | .3239 | .085 | .3234 | .085 | .3197 | .085 | .3183 | .085 | .3166 | .084 | .3151 | .084 | .3139 | .084 | 1220 |
| .3924 | .085 | .3506 | .085 | .3489 | .085 | .3478 | .085 | .3456 | .085 | .3440 | .085 | .3422 | .084 | .3416 | .084 | .3391 | .084 | .3375 | .084 | .3361 | .083 | .3345 | .083 | .3330 | .083 | 1230 |
| .3709 | .085 | .3693 | .085 | .3574 | .085 | .3657 | .085 | .3640 | .035 | .3625 | .085 | .3608 | .084 | .3591 | .084 | .3576 | .084 | .3560 | .084 | .3545 | .083 | .3530 | .083 | .3523 | .083 | 1240 |
| .3886 | .084 | .3869 | .084 | .3851 | .084 | .3833 | .084 | .3817 | .084 | .3800 | .083 | .3784 | .083 | .3780 | .083 | .3753 | .083 | .3736 | .083 | .3722 | .082 | .3707 | .082 | .3692 | .082 | 1250 |
| .4057 | .085 | .4040 | .084 | .4023 | .084 | .4005 | .084 | .3988 | .084 | .3972 | .084 | .3955 | .083 | .3959 | .083 | .3923 | .083 | .3909 | .083 | .3893 | .082 | .3877 | .082 | .3863 | .082 | 1260 |
| .4221 | .084 | .4203 | .083 | .4186 | .083 | .4168 | .083 | .4151 | .083 | .4136 | .083 | .4120 | .083 | .4108 | .082 | .4087 | .082 | .4072 | .082 | .4057 | .082 | .4042 | .082 | .4028 | .082 | 1270 |
| .4379 | .083 | .4362 | .083 | .4344 | .083 | .4326 | .083 | .4310 | .083 | .4294 | .082 | .4276 | .082 | .4280 | .082 | .4246 | .081 | .4231 | .081 | .4214 | .081 | .4200 | .081 | .4186 | .081 | 1280 |
| .4532 | .082 | .4513 | .082 | .4496 | .082 | .4479 | .082 | .4462 | .082 | .4447 | .082 | .4429 | .082 | .4414 | .082 | .4398 | .081 | .4382 | .081 | .4366 | .081 | .4352 | .080 | .4338 | .080 | 1290 |
| .4678 | .082 | .4660 | .082 | .4643 | .082 | .4625 | .082 | .4609 | .082 | .4592 | .081 | .4576 | .081 | .4581 | .081 | .4545 | .080 | .4529 | .080 | .4513 | .080 | .4499 | .080 | .4486 | .080 | 1300 |
| .4822 | .082 | .4803 | .082 | .4786 | .081 | .4768 | .081 | .4752 | .081 | .4736 | .081 | .4719 | .081 | .4708 | .081 | .4688 | .080 | .4672 | .080 | .4657 | .080 | .4642 | .080 | .4628 | .080 | 1310 |
| .4958 | .080 | .4940 | .080 | .4923 | .080 | .4905 | .080 | .4888 | .080 | .4873 | .079 | .4856 | .079 | .4860 | .079 | .4824 | .079 | .4809 | .079 | .4794 | .079 | .4780 | .079 | .4765 | .079 | 1320 |
| .5092 | .080 | .5075 | .080 | .5057 | .080 | .5039 | .080 | .5023 | .080 | .5006 | .080 | .4990 | .080 | .4983 | .080 | .4958 | .079 | .4943 | .079 | .4928 | .079 | .4914 | .079 | .4900 | .079 | 1330 |
| .6222 | .080 | .5204 | .080 | .5186 | .079 | .5169 | .079 | .5153 | .079 | .5136 | .079 | .5120 | .079 | .5104 | .079 | .5089 | .079 | .5073 | .079 | .5058 | .079 | .5043 | .079 | .5028 | .079 | 1340 |
| .5348 | .079 | .5330 | .079 | .5313 | .079 | .5296 | .079 | .5279 | .079 | .5263 | .079 | .5247 | .079 | .5231 | .079 | .5215 | .078 | .5200 | .078 | .5184 | .078 | .5169 | .078 | .5155 | .078 | 1350 |
| .5470 | .078 | .5452 | .078 | .5434 | .078 | .5417 | .078 | .5401 | .078 | .5384 | .077 | .5368 | .077 | .5352 | .077 | .5336 | .077 | .5321 | .077 | .5306 | .077 | .5291 | .077 | .5276 | .077 | 1360 |
| .5589 | .078 | .5571 | .078 | .5553 | .077 | .5536 | .077 | .5519 | .077 | .5504 | .077 | .5488 | .077 | .5472 | .077 | .5456 | .076 | .5439 | .076 | .5424 | .076 | .5410 | .076 | .5396 | .076 | 1370 |
| .5705 | .078 | .5688 | .078 | .5670 | .078 | .5653 | .078 | .5636 | .078 | .5619 | .077 | .5603 | .077 | .5588 | .077 | .5572 | .077 | .5556 | .077 | .5541 | .077 | .5527 | .077 | .5512 | .077 | 1380 |
| .5818 | .077 | .5800 | .077 | .5783 | .077 | .5766 | .077 | .5750 | .077 | .5733 | .077 | .5716 | .077 | .5700 | .077 | .5684 | .076 | .5669 | .076 | .5654 | .076 | .5640 | .076 | .5625 | .076 | 1390 |
| .5928 | .076 | .5911 | .076 | .5893 | .076 | .5876 | .076 | .5859 | .076 | .5843 | .076 | .5826 | .076 | .5811 | .076 | .5794 | .075 | .5780 | .075 | .5765 | .075 | .5750 | .075 | .5734 | .075 | 1400 |
| .6036 | .076 | .6017 | .076 | .6000 | .075 | .5982 | .075 | .5966 | .075 | .5949 | .075 | .5933 | .075 | .5912 | .075 | .5902 | .075 | .5886 | .075 | .5871 | .075 | .5857 | .075 | .5842 | .075 | 1410 |
| .6139 | .074 | .6121 | .074 | .6104 | .074 | .6087 | .074 | .6070 | .074 | .6053 | .074 | .6037 | .074 | .6028 | .074 | .6005 | .074 | .5990 | .074 | .5975 | .074 | .5960 | .074 | .5946 | .074 | 1420 |
| .6242 | .075 | .6224 | .075 | .6207 | .075 | .6189 | .075 | .6173 | .075 | .6157 | .075 | .6140 | .075 | .6123 | .075 | .6109 | .074 | .6093 | .074 | .6078 | .074 | .6063 | .074 | .6049 | .074 | 1430 |
| .6342 | .073 | .6324 | .073 | .6306 | .073 | .6289 | .073 | .6273 | .073 | .6256 | .073 | .6240 | .073 | .6224 | .073 | .6209 | .073 | .6193 | .073 | .6177 | .073 | .6163 | .073 | .6149 | .073 | 1440 |
| .6439 | .073 | .6422 | .073 | .6404 | .073 | .6387 | .073 | .6370 | .073 | .6354 | .073 | .6338 | .072 | .6322 | .072 | .6305 | .072 | .6290 | .072 | .6275 | .072 | .6271 | .072 | .6246 | .073 | 1450 |
| .6535 | .073 | .6517 | .073 | .6499 | .073 | .6483 | .073 | .6466 | .073 | .6449 | .073 | .6434 | .073 | .6418 | .073 | .6402 | .073 | .6386 | .073 | .6371 | .073 | .6356 | .073 | .6342 | .072 | 1460 |
| .6628 | .071 | .6610 | .071 | .6592 | .071 | .6575 | .071 | .6559 | .071 | .6543 | .071 | .6526 | .071 | .6528 | .071 | .6495 | .071 | .6480 | .071 | .6464 | .071 | .6449 | .071 | .6434 | .071 | 1470 |
| .6719 | .071 | .6702 | .071 | .6684 | .071 | .6667 | .071 | .6650 | .071 | .6633 | .071 | .6617 | .071 | .6604 | .071 | .6585 | .071 | .6571 | .071 | .6555 | .071 | .6540 | .071 | .6525 | .071 | 1480 |
| .6809 | .071 | .6791 | .071 | .6773 | .071 | .6757 | .071 | .6740 | .071 | .6724 | .071 | .6707 | .071 | .6691 | .071 | .6675 | .071 | .6660 | .071 | .6645 | .071 | .6630 | .071 | .6616 | .071 | 1490 |
| .6898 | .071 | .6879 | .071 | .6861 | .071 | .6844 | .071 | .6828 | .071 | .6812 | .071 | .6795 | .071 | .6779 | .071 | .6763 | .071 | .6748 | .071 | .6733 | .071 | .6718 | .071 | .6703 | .071 | 1500 |

Weight in Grams of One Liter of Wet Pulp

in. or over may be found in tanks over 25 ft. in diameter, due to imperfect construction, unequal settling or unequal shrinkage of the staves. In order that an accurate diameter be obtained, it is necessary to make a number of measurements at different depths and preferably at equal angles and take the average of the results thus obtained as being the true diameter. The diameters of steel tanks are also subject to variations due to poor construction and unequal settling, therefore the same directions should be observed as in the case of wooden

NOTE—The characteristics of the logarithms in the above table can be determined as was done in Table 1. They are all either 0 or 1. See footnote on p. 1084

TABLE IV. NUMBER OF CUBIC FEET OF WET PULP TO MAKE ONE TON OF DRY SLIME

Formula: $\frac{2000}{64.42\ a\ \frac{P}{100}}$

Specific Gravity of Dry Slime

Weight in Grams of One Liter of Wet Pulp

| | 2.50 | Correction | 2.52 | Correction | 2.54 | Correction | 2.56 | Correction | 2.58 | Correction | 2.60 | Correction | 2.62 | Correction | 2.64 | Correction | 2.66 | Correction | 2.68 | Correction | 2.70 | Correction | 2.72 | Correction | 2.74 | Correction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | 1923 | | 1933 | | 1943 | | 1953 | | 1963 | | 1972 | | 1981 | | 1990 | | 1999 | | 2008 | | 2017 | | 2026 | | 2034 | |
| 1020 | 961.4 | 94.9 | 966.3 | 95.4 | 971.4 | 95.9 | 976.4 | 96.4 | 981.2 | 96.9 | 985.8 | 97.3 | 990.6 | 97.8 | 995.2 | 98.3 | 999.8 | 98.8 | 1004 | 99.3 | 1009 | 99.7 | 1013 | 100.1 | 1017 | 100.5 |
| 1030 | 640.9 | 31.41 | 644.2 | 31.59 | 647.6 | 31.76 | 650.9 | 31.93 | 654.1 | 32.09 | 657.2 | 32.26 | 660.3 | 32.42 | 663.4 | 32.58 | 666.5 | 32.73 | 669.5 | 32.89 | 672.4 | 33.10 | 675.3 | 33.2 | 678.2 | 33.30 |
| 1040 | 480.6 | 15.60 | 483.1 | 15.69 | 485.6 | 15.78 | 488.1 | 15.87 | 490.5 | 15.95 | 492.9 | 16.03 | 495.2 | 16.11 | 497.5 | 16.19 | 499.8 | 16.27 | 502.1 | 16.35 | 504.3 | 16.43 | 506.4 | 16.50 | 508.5 | 16.58 |
| 1050 | 384.5 | 9.29 | 386.5 | 9.35 | 388.5 | 9.40 | 390.5 | 9.45 | 392.4 | 9.50 | 394.3 | 9.55 | 396.2 | 9.60 | 398.0 | 9.65 | 399.9 | 9.69 | 401.7 | 9.74 | 403.4 | 9.79 | 405.1 | 9.84 | 406.8 | 9.88 |
| 1060 | 320.4 | 6.15 | 322.0 | 6.19 | 323.7 | 6.23 | 325.4 | 6.26 | 327.0 | 6.29 | 328.5 | 6.33 | 330.1 | 6.36 | 331.7 | 6.40 | 333.2 | 6.43 | 334.7 | 6.46 | 336.1 | 6.49 | 337.6 | 6.52 | 339.0 | 6.55 |
| 1070 | 274.7 | 4.36 | 276.1 | 4.39 | 277.5 | 4.42 | 278.9 | 4.44 | 280.3 | 4.46 | 281.7 | 4.48 | 283.0 | 4.51 | 284.3 | 4.53 | 285.6 | 4.56 | 286.9 | 4.58 | 288.1 | 4.60 | 289.4 | 4.62 | 290.6 | 4.64 |
| 1080 | 240.3 | 3.25 | 241.5 | 3.28 | 242.8 | 3.30 | 244.1 | 3.32 | 245.3 | 3.33 | 246.4 | 3.35 | 247.6 | 3.37 | 248.8 | 3.39 | 249.9 | 3.40 | 251.0 | 3.42 | 252.1 | 3.44 | 253.2 | 3.45 | 254.3 | 3.47 |
| 1090 | 213.6 | 2.51 | 214.7 | 2.53 | 215.9 | 2.54 | 217.0 | 2.55 | 218.1 | 2.56 | 219.1 | 2.58 | 220.1 | 2.60 | 221.2 | 2.61 | 222.2 | 2.62 | 223.2 | 2.64 | 224.1 | 2.66 | 225.1 | 2.67 | 226.0 | 2.68 |
| 1100 | 192.3 | 1.99 | 193.3 | 2.00 | 194.3 | 2.02 | 195.3 | 2.03 | 196.2 | 2.05 | 197.2 | 2.06 | 198.1 | 2.07 | 199.0 | 2.08 | 199.9 | 2.10 | 200.8 | 2.11 | 201.7 | 2.11 | 202.6 | 2.12 | 203.4 | 2.13 |
| 1110 | 174.8 | 1.62 | 175.7 | 1.63 | 176.6 | 1.64 | 177.5 | 1.65 | 178.4 | 1.66 | 179.2 | 1.67 | 180.1 | 1.68 | 180.9 | 1.69 | 181.8 | 1.70 | 182.6 | 1.71 | 183.4 | 1.71 | 184.2 | 1.72 | 184.9 | 1.73 |
| 1120 | 160.2 | 1.34 | 161.0 | 1.35 | 161.9 | 1.36 | 162.7 | 1.37 | 163.5 | 1.38 | 164.3 | 1.38 | 165.1 | 1.39 | 165.8 | 1.40 | 166.6 | 1.41 | 167.4 | 1.41 | 168.1 | 1.42 | 168.8 | 1.43 | 169.5 | 1.43 |
| 1130 | 147.9 | 1.12 | 148.7 | 1.13 | 149.4 | 1.14 | 150.2 | 1.14 | 151.0 | 1.15 | 151.7 | 1.16 | 152.4 | 1.17 | 153.1 | 1.17 | 153.8 | 1.18 | 154.5 | 1.19 | 155.2 | 1.19 | 155.8 | 1.20 | 156.5 | 1.20 |
| 1140 | 137.3 | .96 | 138.0 | .96 | 138.8 | .97 | 139.5 | .97 | 140.2 | .98 | 140.8 | .99 | 141.5 | 1.00 | 142.2 | 1.00 | 142.8 | 1.01 | 143.5 | 1.01 | 144.1 | 1.02 | 144.7 | 1.03 | 145.3 | 1.03 |
| 1150 | 128.2 | .82 | 128.8 | .83 | 129.5 | .84 | 130.2 | .84 | 130.8 | .85 | 131.4 | .85 | 132.1 | .85 | 132.7 | .86 | 133.3 | .87 | 133.9 | .87 | 134.5 | .88 | 135.0 | .89 | 135.6 | .89 |
| 1160 | 120.2 | .71 | 120.8 | .72 | 121.4 | .73 | 122.0 | .73 | 122.6 | .74 | 123.2 | .74 | 123.8 | .75 | 124.4 | .75 | 125.0 | .75 | 125.5 | .76 | 126.1 | .76 | 126.6 | .77 | 127.1 | .77 |
| 1170 | 113.1 | .63 | 113.7 | .63 | 114.3 | .63 | 114.9 | .63 | 115.5 | .64 | 116.0 | .64 | 116.5 | .65 | 117.1 | .65 | 117.6 | .66 | 118.2 | .66 | 118.7 | .66 | 119.2 | .67 | 119.7 | .67 |
| 1180 | 106.8 | .56 | 107.4 | .56 | 107.9 | .57 | 108.5 | .57 | 109.0 | .57 | 109.5 | .57 | 110.1 | .57 | 110.6 | .57 | 111.1 | .58 | 111.6 | .59 | 112.0 | .59 | 112.5 | .60 | 113.0 | .60 |
| 1190 | 101.2 | .49 | 101.7 | .49 | 102.2 | .50 | 102.8 | .50 | 103.3 | .50 | 103.8 | .50 | 104.3 | .51 | 104.7 | .51 | 105.2 | .52 | 105.7 | .52 | 106.1 | .52 | 106.6 | .53 | 107.1 | .53 |
| 1200 | 96.14 | .44 | 96.63 | .44 | 97.14 | .45 | 97.64 | .45 | 98.12 | .45 | 98.58 | .45 | 99.06 | .45 | 99.52 | .46 | 99.98 | .46 | 100.4 | .47 | 100.9 | .47 | 101.3 | .47 | 101.7 | .47 |
| 1210 | 91.56 | .394 | 92.03 | .398 | 92.51 | .401 | 92.98 | .404 | 93.44 | .406 | 93.89 | .409 | 94.34 | .411 | 94.78 | .414 | 95.21 | .417 | 95.64 | .420 | 96.06 | .420 | 96.47 | .42 | 96.88 | .42 |
| 1220 | 87.39 | .356 | 87.85 | .359 | 88.31 | .361 | 88.76 | .363 | 89.20 | .365 | 89.63 | .368 | 90.05 | .371 | 90.47 | .374 | 90.89 | .376 | 91.30 | .378 | 91.70 | .381 | 92.09 | .383 | 92.48 | .385 |
| 1230 | 83.59 | .323 | 84.03 | .325 | 84.47 | .327 | 84.90 | .329 | 85.32 | .331 | 85.73 | .333 | 86.14 | .336 | 86.54 | .338 | 86.94 | .340 | 87.33 | .343 | 87.71 | .345 | 88.09 | .347 | 88.46 | .349 |
| 1240 | 80.11 | .293 | 80.53 | .296 | 80.95 | .298 | 81.36 | .300 | 81.76 | .302 | 82.16 | .304 | 82.55 | .306 | 82.93 | .308 | 83.31 | .311 | 83.69 | .313 | 84.05 | .31 | 84.41 | .317 | 84.77 | .318 |
| 1250 | 76.91 | .266 | 77.31 | .269 | 77.71 | .272 | 78.11 | .274 | 78.50 | .275 | 78.88 | .277 | 79.25 | .279 | 79.62 | .281 | 79.99 | .283 | 80.35 | .285 | 80.70 | .28 | 81.04 | .289 | 81.38 | .290 |
| 1260 | 73.94 | .246 | 74.32 | .248 | 74.71 | .250 | 75.09 | .252 | 75.47 | .253 | 75.83 | .255 | 76.19 | .257 | 76.54 | .259 | 76.90 | .261 | 77.24 | .263 | 77.58 | .264 | 77.91 | .266 | 78.24 | .267 |
| 1270 | 71.20 | .225 | 71.57 | .227 | 71.94 | .229 | 72.31 | .231 | 72.67 | .232 | 73.02 | .234 | 73.37 | .235 | 73.71 | .237 | 74.05 | .239 | 74.38 | .241 | 74.70 | .242 | 75.02 | .244 | 75.34 | .245 |
| 1280 | 68.66 | .207 | 69.01 | .209 | 69.37 | .211 | 69.73 | .212 | 70.08 | .214 | 70.41 | .216 | 70.74 | .217 | 71.07 | .219 | 71.40 | .221 | 71.72 | .222 | 72.03 | .223 | 72.34 | .225 | 72.64 | .226 |
| 1290 | 66.30 | .190 | 66.64 | .192 | 66.99 | .194 | 67.33 | .195 | 67.67 | .197 | 67.99 | .198 | 68.31 | .200 | 68.63 | .202 | 68.95 | .203 | 69.26 | .204 | 69.55 | .206 | 69.85 | .207 | 70.15 | .208 |
| 1300 | 64.09 | .177 | 64.42 | .179 | 64.76 | .180 | 65.09 | .181 | 65.41 | .183 | 65.72 | .184 | 66.03 | .186 | 66.34 | .188 | 66.65 | .189 | 66.95 | .190 | 67.24 | .191 | 67.53 | .192 | 67.81 | .193 |
| 1310 | 62.02 | .165 | 62.33 | .167 | 62.66 | .168 | 62.98 | .169 | 63.30 | .171 | 63.60 | .172 | 63.90 | .173 | 64.19 | .175 | 64.49 | .177 | 64.78 | .178 | 65.06 | .179 | 65.34 | .180 | 65.62 | .181 |
| 1320 | 60.09 | .151 | 60.40 | .153 | 60.71 | .154 | 61.02 | .155 | 61.33 | .157 | 61.63 | .158 | 61.92 | .159 | 62.20 | .161 | 62.49 | .162 | 62.77 | .163 | 63.04 | .164 | 63.31 | .165 | 63.58 | .166 |
| 1330 | 58.26 | .143 | 58.56 | .144 | 58.87 | .145 | 59.17 | .146 | 59.47 | .148 | 59.75 | .149 | 60.03 | .150 | 60.31 | .151 | 60.59 | .152 | 60.87 | .153 | 61.13 | .154 | 61.39 | .155 | 61.65 | .156 |
| 1340 | 56.54 | .134 | 56.83 | .135 | 57.13 | .136 | 57.42 | .137 | 57.71 | .138 | 57.99 | .139 | 58.26 | .140 | 58.53 | .141 | 58.80 | .142 | 59.07 | .143 | 59.32 | .144 | 59.58 | .145 | 59.83 | .146 |
| 1350 | 54.93 | .124 | 55.21 | .125 | 55.50 | .126 | 55.78 | .127 | 56.06 | .128 | 56.33 | .129 | 56.60 | .130 | 56.86 | .131 | 57.13 | .132 | 57.39 | .133 | 57.63 | .134 | 57.88 | .135 | 58.12 | .136 |
| 1360 | 53.41 | .116 | 53.68 | .117 | 53.96 | .118 | 54.24 | .119 | 54.51 | .120 | 54.77 | .121 | 55.03 | .122 | 55.28 | .123 | 55.54 | .124 | 55.79 | .125 | 56.03 | .125 | 56.27 | .126 | 56.51 | .127 |
| 1370 | 51.96 | .109 | 52.23 | .110 | 52.50 | .111 | 52.77 | .112 | 53.04 | .113 | 53.29 | .114 | 53.54 | .115 | 53.79 | .116 | 54.04 | .117 | 54.28 | .118 | 54.51 | .119 | 54.75 | .120 | 54.98 | .121 |
| 1380 | 50.59 | .103 | 50.85 | .103 | 51.12 | .104 | 51.38 | .105 | 51.64 | .106 | 51.88 | .107 | 52.13 | .108 | 52.37 | .108 | 52.62 | .109 | 52.86 | .110 | 53.09 | .111 | 53.31 | .112 | 53.53 | .113 |
| 1390 | 49.28 | .097 | 49.55 | .098 | 49.81 | .099 | 50.06 | .099 | 50.31 | .100 | 50.55 | .101 | 50.79 | .102 | 51.03 | .103 | 51.26 | .104 | 51.48 | .105 | 51.71 | .106 | 51.93 | .107 | 52.15 | .107 |
| 1400 | 48.06 | .091 | 48.31 | .092 | 48.56 | .093 | 48.81 | .093 | 49.05 | .094 | 49.29 | .095 | 49.52 | .096 | 49.75 | .096 | 49.98 | .097 | 50.21 | .098 | 50.42 | .099 | 50.64 | .100 | 50.85 | .101 |
| 1410 | 46.89 | .086 | 47.13 | .087 | 47.38 | .088 | 47.62 | .088 | 47.86 | .089 | 48.09 | .090 | 48.32 | .090 | 48.54 | .091 | 48.77 | .092 | 48.99 | .092 | 49.20 | .093 | 49.41 | .094 | 49.62 | .094 |
| 1420 | 45.78 | .081 | 46.02 | .082 | 46.26 | .083 | 46.49 | .083 | 46.72 | .084 | 46.95 | .085 | 47.17 | .085 | 47.39 | .086 | 47.61 | .087 | 47.83 | .087 | 48.03 | .088 | 48.24 | .089 | 48.44 | .089 |
| 1430 | 44.71 | .077 | 44.94 | .078 | 45.17 | .079 | 45.40 | .079 | 45.63 | .080 | 45.85 | .081 | 46.07 | .081 | 46.28 | .082 | 46.50 | .083 | 46.71 | .083 | 46.91 | .084 | 47.11 | .085 | 47.31 | .085 |
| 1440 | 43.69 | .072 | 43.92 | .073 | 44.15 | .074 | 44.37 | .074 | 44.59 | .075 | 44.81 | .076 | 45.02 | .076 | 45.23 | .077 | 45.44 | .078 | 45.64 | .078 | 45.84 | .079 | 46.04 | .080 | 46.23 | .080 |
| 1450 | 42.73 | .068 | 42.95 | .069 | 43.17 | .069 | 43.39 | .070 | 43.61 | .070 | 43.82 | .071 | 44.03 | .071 | 44.23 | .072 | 44.44 | .072 | 44.64 | .073 | 44.83 | .073 | 45.02 | .074 | 45.21 | .075 |
| 1460 | 41.79 | .065 | 42.01 | .066 | 42.23 | .066 | 42.44 | .067 | 42.65 | .067 | 42.86 | .068 | 43.06 | .069 | 43.26 | .070 | 43.46 | .071 | 43.66 | .071 | 43.85 | .072 | 44.03 | .073 | 44.22 | .073 |
| 1470 | 40.91 | .061 | 41.12 | .061 | 41.33 | .062 | 41.54 | .063 | 41.75 | .064 | 41.95 | .065 | 42.15 | .065 | 42.35 | .066 | 42.54 | .066 | 42.73 | .067 | 42.92 | .067 | 43.10 | .068 | 43.28 | .068 |
| 1480 | 40.06 | .058 | 40.26 | .058 | 40.48 | .059 | 40.68 | .060 | 40.89 | .060 | 41.08 | .061 | 41.28 | .061 | 41.47 | .062 | 41.66 | .063 | 41.85 | .063 | 42.02 | .064 | 42.20 | .065 | 42.38 | .065 |
| 1490 | 39.24 | .055 | 32.44 | .056 | 39.65 | .057 | 39.85 | .057 | 40.05 | .058 | 40.23 | .059 | 40.43 | .059 | 40.62 | .060 | 40.80 | .061 | 40.99 | .061 | 41.16 | .062 | 41.34 | .063 | 41.51 | .063 |
| 1500 | 38.45 | .053 | 38.65 | .053 | 38.85 | .054 | 39.05 | .054 | 39.25 | .055 | 39.43 | .056 | 39.62 | .056 | 39.80 | .057 | 39.99 | .058 | 40.17 | .058 | 40.34 | .059 | 40.51 | .059 | 40.68 | .060 |

TABLE IV-A. LOGARITHMS OF NUMBER OF CUBIC FEET OF WET PULP TO MAKE ONE TON OF DRY SLIME

Specific Gravity of Dry Slime

Weight in Grams of One Liter of Wet Pulp

| | 2.50 | Correction | 2.52 | Correction | 2.54 | Correction | 2.56 | Correction | 2.58 | Correction | 2.60 | Correction | 2.62 | Correction | 2.64 | Correction | 2.66 | Correction | 2.68 | Correction | 2.70 | Correction | 2.72 | Correction | 2.74 | Correction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | .2840 | | .2862 | | .2885 | | .2907 | | .2929 | | .2949 | | .2969 | | .2989 | | .3008 | | .3028 | | .3047 | | .3066 | | .3084 | |
| 1020 | .9829 | 94.9 | .9851 | 95.4 | .9874 | 95.9 | .9896 | 96.4 | .9918 | 96.9 | .9938 | 97.3 | .9959 | 97.8 | .9979 | 98.3 | .9990 | 98.8 | .0017 | 99.3 | .0039 | 99.7 | .0056 | 100.1 | .0073 | 100.5 |
| 1030 | .8068 | 31.41 | .8090 | 31.59 | .8113 | 31.76 | .8135 | 31.93 | .8156 | 32.09 | .8177 | 32.26 | .8197 | 32.42 | .8218 | 32.58 | .8238 | 32.73 | .8258 | 32.89 | .8276 | 33.1 | .8295 | 33.2 | .8314 | 33.3 |
| 1040 | .6818 | 15.60 | .6840 | 15.69 | .6863 | 15.78 | .6885 | 15.87 | .6906 | 15.95 | .6928 | 16.03 | .6948 | 16.11 | .6968 | 16.19 | .6988 | 16.27 | .7008 | 16.35 | .7027 | 16.43 | .7045 | 16.50 | .7063 | 16.58 |
| 1050 | .5849 | 9.29 | .5871 | 9.35 | .5894 | 9.40 | .5916 | 9.45 | .5936 | 9.50 | .5958 | 9.55 | .5979 | 9.60 | .5999 | 9.65 | .6020 | 9.69 | .6039 | 9.74 | .6057 | 9.79 | .6076 | 9.84 | .6094 | 9.88 |
| 1060 | .5057 | 6.15 | .5079 | 6.19 | .5101 | 6.23 | .5124 | 6.26 | .5145 | 6.29 | .5165 | 6.33 | .5186 | 6.36 | .5207 | 6.40 | .5227 | 6.43 | .5247 | 6.46 | .5265 | 6.49 | .5284 | 6.52 | .5302 | 6.55 |
| 1070 | .4389 | 4.36 | .4411 | 4.39 | .4433 | 4.42 | .4454 | 4.44 | .4476 | 4.46 | .4498 | 4.48 | .4518 | 4.51 | .4538 | 4.53 | .4558 | 4.56 | .4577 | 4.58 | .4595 | 4.60 | .4615 | 4.62 | .4633 | 4.64 |
| 1080 | .3808 | 3.25 | .3829 | 3.28 | .3852 | 3.30 | .3876 | 3.32 | .3897 | 3.33 | .3916 | 3.35 | .3938 | 3.37 | .3959 | 3.39 | .3978 | 3.40 | .3997 | 3.42 | .4016 | 3.44 | .4035 | 3.45 | .4053 | 3.47 |
| 1090 | .3296 | 2.51 | .3318 | 2.53 | .3342 | 2.54 | .3365 | 2.55 | .3387 | 2.56 | .3406 | 2.58 | .3426 | 2.60 | .3448 | 2.61 | .3467 | 2.62 | .3487 | 2.64 | .3504 | 2.66 | .3524 | 2.67 | .3541 | 2.68 |
| 1100 | .2840 | 1.99 | .2862 | 2.00 | .2885 | 2.02 | .2907 | 2.03 | .2927 | 2.05 | .2949 | 2.06 | .2969 | 2.07 | .2989 | 2.08 | .3008 | 2.10 | .3028 | 2.11 | .3047 | 2.11 | .3066 | 2.12 | .3084 | 2.13 |
| 1110 | .2425 | 1.62 | .2448 | 1.63 | .2470 | 1.64 | .2492 | 1.65 | .2514 | 1.66 | .2534 | 1.67 | .2555 | 1.68 | .2574 | 1.69 | .2596 | 1.70 | .2615 | 1.71 | .2634 | 1.71 | .2653 | 1.72 | .2672 | 1.73 |
| 1120 | .2048 | 1.34 | .2068 | 1.35 | .2092 | 1.36 | .2114 | 1.37 | .2135 | 1.38 | .2156 | 1.38 | .2177 | 1.39 | .2196 | 1.40 | .2218 | 1.41 | .2236 | 1.41 | .2256 | 1.42 | .2274 | 1.43 | .2292 | 1.43 |
| 1130 | .1700 | 1.12 | .1723 | 1.13 | .1745 | 1.14 | .1767 | 1.14 | .1790 | 1.15 | .1810 | 1.16 | .1830 | 1.17 | .1850 | 1.17 | .1870 | 1.18 | .1889 | 1.19 | .1909 | 1.19 | .1926 | 1.20 | .1945 | 1.20 |
| 1140 | .1377 | .96 | .1400 | .96 | .1424 | .97 | .1446 | .97 | .1467 | .98 | .1486 | .99 | .1508 | 1.00 | .1529 | 1.00 | .1547 | 1.01 | .1569 | 1.01 | .1587 | 1.02 | .1605 | 1.03 | .1623 | 1.03 |
| 1150 | .1079 | .82 | .1099 | .83 | .1123 | .84 | .1146 | .84 | .1166 | .85 | .1186 | .85 | .1209 | .85 | .1229 | .86 | .1248 | .87 | .1268 | .87 | .1287 | .88 | .1303 | .89 | .1323 | .89 |
| 1160 | .0799 | .71 | .0821 | .72 | .0842 | .73 | .0864 | .73 | .0885 | .74 | .0906 | .74 | .0927 | .75 | .0948 | .75 | .0969 | .75 | .0986 | .76 | .1007 | .76 | .1024 | .77 | .1041 | .77 |
| 1170 | .0535 | .63 | .0558 | .63 | .0580 | .63 | .0603 | .63 | .0626 | .64 | .0643 | .64 | .0663 | .65 | .0686 | .65 | .0704 | .66 | .0726 | .66 | .0745 | .66 | .0763 | .67 | .0781 | .67 |
| 1180 | .0286 | .56 | .0310 | .56 | .0330 | .57 | .0354 | .57 | .0374 | .57 | .0394 | .57 | .0418 | .57 | .0438 | .57 | .0457 | .58 | .0477 | .59 | .0492 | .59 | .0512 | .60 | .0531 | .60 |
| 1190 | .0052 | .49 | .0073 | .49 | .0095 | .50 | .0120 | .50 | .0141 | .50 | .0162 | .50 | .0183 | .51 | .0199 | .51 | .0220 | .52 | .0241 | .52 | .0257 | .52 | .0278 | .53 | .0298 | .53 |
| 1200 | .9829 | .44 | .9851 | .44 | .9874 | .45 | .9896 | .45 | .9918 | .45 | .9938 | .45 | .9959 | .45 | .9979 | .46 | .9999 | .46 | .0017 | .47 | .0039 | .47 | .0056 | .47 | .0073 | .47 |
| 1210 | .9617 | .394 | .9639 | .398 | .9662 | .401 | .9684 | .404 | .9705 | .406 | .9726 | .409 | .9747 | .411 | .9767 | .414 | .9787 | .417 | .9806 | .420 | .9825 | .42 | .9844 | .42 | .9862 | .42 |
| 1220 | .9415 | .356 | .9437 | .359 | .9460 | .361 | .9482 | .363 | .9504 | .365 | .9525 | .368 | .9545 | .371 | .9565 | .374 | .9585 | .376 | .9605 | .378 | .9624 | .381 | .9642 | .383 | .9660 | .385 |
| 1230 | .9222 | .323 | .9244 | .325 | .9267 | .327 | .9289 | .329 | .9311 | .331 | .9331 | .333 | .9357 | .336 | .9372 | .338 | .9392 | .340 | .9412 | .343 | .9430 | .345 | .9449 | .347 | .9467 | .345 |
| 1240 | .9037 | .293 | .9060 | .296 | .9082 | .298 | .9104 | .300 | .9125 | .302 | .9147 | .304 | .9167 | .306 | .9187 | .308 | .9207 | .311 | .9227 | .313 | .9245 | .315 | .9264 | .317 | .9282 | .318 |
| 1250 | .8860 | .266 | .8882 | .269 | .8905 | .272 | .8927 | .274 | .8949 | .275 | .8970 | .277 | .8990 | .279 | .9010 | .281 | .9030 | .283 | .9050 | .285 | .9069 | .287 | .9087 | .289 | .9105 | .290 |
| 1260 | .8689 | .246 | .8711 | .248 | .8734 | .250 | .8756 | .252 | .8778 | .253 | .8798 | .255 | .8819 | .257 | .8839 | .259 | .8859 | .261 | .8878 | .263 | .8897 | .264 | .8916 | .266 | .8934 | .267 |
| 1270 | .8525 | .225 | .8547 | .227 | .8570 | .229 | .8592 | .231 | .8614 | .232 | .8634 | .234 | .8655 | .235 | .8675 | .237 | .8695 | .239 | .8715 | .241 | .8733 | .242 | .8752 | .244 | .8770 | .245 |
| 1280 | .8367 | .207 | .8389 | .209 | .8412 | .211 | .8434 | .212 | .8456 | .214 | .8476 | .216 | .8497 | .217 | .8517 | .219 | .8537 | .221 | .8556 | .222 | .8575 | .223 | .8594 | .225 | .8612 | .229 |
| 1290 | .8215 | .190 | .8237 | .192 | .8260 | .194 | .8282 | .195 | .8304 | .197 | .8324 | .198 | .8345 | .200 | .8365 | .202 | .8385 | .203 | .8405 | .204 | .8423 | .206 | .8442 | .207 | .8460 | .208 |
| 1300 | .8068 | .177 | .8090 | .179 | .8113 | .180 | .8135 | .181 | .8156 | .183 | .8177 | .184 | .8197 | .186 | .8218 | .188 | .8238 | .189 | .8258 | .190 | .8276 | .191 | .8295 | .192 | .8313 | .193 |
| 1310 | .7925 | .165 | .7947 | .167 | .7970 | .168 | .7992 | .169 | .8014 | .171 | .8035 | .172 | .8055 | .173 | .8075 | .175 | .8095 | .177 | .8114 | .178 | .8133 | .179 | .8152 | .180 | .8578 | .181 |
| 1320 | .7782 | .151 | .7810 | .153 | .7832 | .154 | .7855 | .155 | .7877 | .157 | .7896 | .158 | .7918 | .159 | .7938 | .161 | .7958 | .162 | .7978 | .163 | .7996 | .164 | .8075 | .165 | .8033 | .169 |
| 1330 | .7654 | .143 | .7676 | .144 | .7699 | .145 | .7721 | .146 | .7743 | .148 | .7763 | .149 | .7784 | .150 | .7804 | .151 | .7824 | .152 | .7844 | .153 | .7862 | .154 | .7881 | .155 | .7899 | .156 |
| 1340 | .7524 | .134 | .7546 | .135 | .7569 | .136 | .7591 | .137 | .7612 | .138 | .7634 | .139 | .7654 | .140 | .7674 | .141 | .7694 | .142 | .7714 | .143 | .7732 | .144 | .7751 | .145 | .7769 | .146 |
| 1350 | .7398 | .124 | .7420 | .125 | .7443 | .126 | .7465 | .127 | .7487 | .128 | .7507 | .129 | .7528 | .130 | .7548 | .131 | .7569 | .132 | .7588 | .133 | .7606 | .134 | .7625 | .135 | .7643 | .136 |
| 1360 | .7276 | .116 | .7298 | .117 | .7321 | .118 | .7343 | .119 | .7365 | .120 | .7385 | .121 | .7406 | .122 | .7426 | .123 | .7446 | .124 | .7466 | .125 | .7484 | .125 | .7503 | .126 | .7521 | .127 |
| 1370 | .7157 | .109 | .7179 | .110 | .7202 | .111 | .7224 | .112 | .7246 | .113 | .7266 | .114 | .7287 | .115 | .7307 | .116 | .7327 | .117 | .7346 | .118 | .7365 | .119 | .7384 | .120 | .7402 | .120 |
| 1380 | .7041 | .103 | .7063 | .103 | .7086 | .104 | .7108 | .105 | .7130 | .106 | .7150 | .107 | .7171 | .108 | .7191 | .108 | .7212 | .109 | .7231 | .110 | .7250 | .111 | .7268 | .112 | .7286 | .113 |
| 1390 | .6928 | .097 | .6950 | .098 | .6973 | .099 | .6995 | .099 | .7017 | .100 | .7037 | .101 | .7058 | .102 | .7078 | .103 | .7098 | .104 | .7117 | .105 | .7136 | .106 | .7154 | .107 | .7172 | .107 |
| 1400 | .6818 | .091 | .6840 | .092 | .6863 | .093 | .6885 | .093 | .6906 | .094 | .6928 | .095 | .6948 | .096 | .6968 | .096 | .6988 | .097 | .7008 | .098 | .7026 | .099 | .7045 | .100 | .7063 | .101 |
| 1410 | .6711 | .086 | .6733 | .087 | .6756 | .088 | .6778 | .088 | .6798 | .089 | .6820 | .090 | .6841 | .090 | .6861 | .091 | .6882 | .092 | .6901 | .092 | .6920 | .093 | .6938 | .094 | .6956 | .094 |
| 1420 | .6607 | .081 | .6629 | .082 | .6652 | .083 | .6674 | .083 | .6695 | .084 | .6716 | .085 | .6737 | .085 | .6757 | .086 | .6777 | .087 | .6797 | .087 | .6815 | .088 | .6834 | .089 | .6852 | .089 |
| 1430 | .6504 | .077 | .6526 | .078 | .6549 | .079 | .6571 | .079 | .6592 | .080 | .6613 | .081 | .6634 | .081 | .6654 | .082 | .6674 | .083 | .6694 | .083 | .6713 | .084 | .6731 | .085 | .6750 | .085 |
| 1440 | .6404 | .072 | .6427 | .073 | .6449 | .074 | .6471 | .074 | .6492 | .075 | .6514 | .766 | .6534 | .076 | .6554 | .077 | .6574 | .078 | .6594 | .078 | .6612 | .079 | .6631 | .080 | .6649 | .080 |
| 1450 | .6307 | .068 | .6330 | .069 | .6352 | .069 | .6374 | .070 | .6396 | .070 | .6417 | .071 | .6437 | .071 | .6457 | .072 | .6478 | .072 | .6497 | .073 | .6516 | .073 | .6534 | .074 | .6552 | .075 |
| 1460 | .6211 | .065 | .6234 | .066 | .6256 | .066 | .6278 | .067 | .6299 | .067 | .6320 | .068 | .6341 | .069 | .6361 | .070 | .6381 | .071 | .6401 | .071 | .6420 | .072 | .6437 | .073 | .6456 | .073 |
| 1470 | .6118 | .061 | .6140 | .061 | .6163 | .062 | .6185 | .063 | .6207 | .064 | .6227 | .065 | .6248 | .065 | .6268 | .066 | .6288 | .066 | .6307 | .067 | .6327 | .067 | .6345 | .068 | .6363 | .068 |
| 1480 | .6027 | .058 | .6049 | .058 | .6072 | .059 | .6094 | .060 | .6116 | .060 | .6136 | .061 | .6157 | .061 | .6177 | .062 | .6197 | .063 | .6217 | .063 | .6235 | .064 | .6253 | .065 | .6272 | .065 |
| 1490 | .5937 | .055 | .5959 | .056 | .5982 | .057 | .6004 | .057 | .6026 | .058 | .6046 | .059 | .6067 | .059 | .6087 | .060 | .6107 | .061 | .6127 | .061 | .6145 | .062 | .6164 | .063 | .6182 | .063 |
| 1500 | .5849 | .053 | .5871 | .053 | .5894 | .054 | .5916 | .054 | .5938 | .055 | .5958 | .056 | .5979 | .056 | .5999 | .057 | .6020 | .058 | .6039 | .058 | .6057 | .059 | .6076 | .059 | .6084 | .060 |

Note—The natural values are given for the corrections on account of the manner in which they are applied.

tanks. Care must also be exercised in ascertaining the average depth of the pulp. A deduction must be made for the number of cubic feet occupied by various devices sub-

NOTE—The characteristics of the logarithms in the above table can be found as was done in Table 1, but it is safer with this table to look up the natural number in Table 4 and from that calculate the characteristic, which may be either 3, 2 or 1.

TABLE IV. NUMBER OF CUBIC FEET OF WET PULP TO MAKE ONE TON OF DRY SLIME—Continued

Formula: $\frac{2000}{64.42\ a\ \frac{P}{100}}$

Specific Gravity of Dry Slime

| 2.76 | Correction | 2.78 | Correction | 2.80 | Correction | 2.82 | Correction | 2.84 | Correction | 2.86 | Correction | 2.88 | Correction | 2.90 | Correction | 2.92 | Correction | 2.94 | Correction | 2.96 | Correction | 2.98 | Correction | 3.00 | Correction | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2043 | | 2052 | | 2060 | | 2068 | | 2076 | | 2084 | | 2092 | | 2099 | | 2107 | | 2115 | | 2122 | | 2129 | | 2136 | | 1010 | |
| 102.2 | 100.9 | 10.26 | 101.4 | 1030 | 101.8 | 1034 | 102.3 | 1038 | 102.7 | 1042 | 103.1 | 1046 | 103.5 | 1050 | 103.9 | 105.3 | 104.3 | 1057 | 104.7 | 1061 | 105.0 | 1065 | 105.5 | 1068 | 105.8 | 1020 | |
| 681.1 | 33.5 | 683.9 | 33.6 | 686.7 | 33.7 | 689.4 | 33.9 | 692.0 | 34.1 | 694.6 | 34.2 | 697.2 | 34.3 | 699.8 | 34.4 | 702.3 | 34.5 | 704.8 | 34.7 | 707.3 | 34.8 | 709.7 | 34.9 | 712.0 | 35.1 | 1030 | |
| 510.7 | 16.65 | 512.8 | 16.72 | 514.9 | 16.79 | 516.9 | 16.87 | 518.9 | 16.94 | 520.9 | 17.00 | 522.9 | 17.07 | 524.8 | 17.14 | 526.7 | 17.21 | 528.6 | 17.27 | 530.4 | 17.33 | 532.2 | 17.39 | 534.0 | 17.46 | 1040 | |
| 408.6 | 9.92 | 410.3 | 9.97 | 411.9 | 10.02 | 413.5 | 10.07 | 415.1 | 10.11 | 416.7 | 10.14 | 418.3 | 10.18 | 419.9 | 10.22 | 421.4 | 10.26 | 422.9 | 10.30 | 424.4 | 10.34 | 425.8 | 10.38 | 427.2 | 10.42 | 1050 | |
| 340.5 | 6.58 | 341.9 | 6.61 | 343.2 | 6.64 | 344.6 | 6.67 | 345.9 | 6.70 | 347.2 | 6.73 | 348.6 | 6.75 | 349.9 | 6.77 | 351.1 | 6.80 | 352.4 | 6.83 | 353.6 | 6.86 | 354.8 | 6.88 | 356.0 | 6.91 | 1060 | |
| 291.9 | 4.66 | 293.1 | 4.68 | 294.3 | 4.70 | 295.5 | 4.72 | 296.6 | 4.75 | 297.7 | 4.77 | 298.8 | 4.79 | 299.9 | 4.81 | 301.0 | 4.83 | 302.1 | 4.85 | 303.1 | 4.87 | 304.2 | 4.88 | 305.2 | 4.90 | 1070 | |
| 255.4 | 3.48 | 256.4 | 3.50 | 257.5 | 3.51 | 258.5 | 3.53 | 259.5 | 3.55 | 260.5 | 3.56 | 261.5 | 3.58 | 262.4 | 3.59 | 263.3 | 3.61 | 264.3 | 3.62 | 265.2 | 3.64 | 266.1 | 3.65 | 267.0 | 3.67 | 1080 | |
| 227.0 | 2.69 | 228.0 | 2.70 | 228.9 | 2.71 | 229.8 | 2.73 | 230.7 | 2.74 | 231.5 | 2.76 | 232.4 | 2.77 | 233.3 | 2.78 | 234.1 | 2.79 | 235.0 | 2.80 | 235.8 | 2.81 | 236.6 | 2.82 | 237.4 | 2.83 | 1090 | |
| 204.3 | 2.14 | 205.2 | 2.15 | 206.0 | 2.16 | 206.8 | 2.17 | 207.6 | 2.18 | 208.4 | 2.19 | 209.2 | 2.20 | 209.9 | 2.21 | 210.7 | 2.22 | 211.4 | 2.23 | 212.2 | 2.24 | 212.9 | 2.25 | 213.6 | 2.26 | 1100 | |
| 185.7 | 1.74 | 186.5 | 1.75 | 187.2 | 1.76 | 188.0 | 1.77 | 188.7 | 1.78 | 189.4 | 1.79 | 190.2 | 1.79 | 190.9 | 1.80 | 191.5 | 1.81 | 192.2 | 1.82 | 192.9 | 1.82 | 193.6 | 1.82 | 194.2 | 1.83 | 1110 | |
| 170.3 | 1.44 | 171.0 | 1.45 | 171.6 | 1.46 | 172.3 | 1.47 | 172.9 | 1.48 | 173.6 | 1.48 | 174.3 | 1.48 | 174.9 | 1.49 | 175.6 | 1.49 | 176.2 | 1.50 | 176.8 | 1.51 | 177.4 | 1.52 | 178.0 | 1.52 | 1120 | |
| 157.2 | 1.21 | 157.8 | 1.21 | 158.5 | 1.22 | 159.1 | 1.23 | 159.7 | 1.24 | 160.3 | 1.24 | 160.9 | 1.24 | 161.5 | 1.25 | 162.1 | 1.25 | 162.7 | 1.26 | 163.2 | 1.26 | 163.8 | 1.27 | 164.3 | 1.28 | 1130 | |
| 145.9 | 1.04 | 146.5 | 1.04 | 147.1 | 1.05 | 147.7 | 1.05 | 148.3 | 1.06 | 148.8 | 1.06 | 149.4 | 1.06 | 150.0 | 1.07 | 150.5 | 1.07 | 151.0 | 1.08 | 151.6 | 1.08 | 152.1 | 1.09 | 152.6 | 1.09 | 1140 | |
| 136.2 | .89 | 136.7 | .90 | 137.3 | .90 | 137.9 | .90 | 138.4 | .91 | 138.9 | .91 | 139.4 | .92 | 139.9 | .93 | 140.4 | .93 | 140.9 | .94 | 141.4 | .94 | 141.9 | .94 | 142.4 | .94 | 1150 | |
| 127.7 | .77 | 128.2 | .78 | 128.7 | .79 | 129.2 | .79 | 129.7 | .80 | 130.2 | .80 | 130.7 | .80 | 131.2 | .80 | 131.7 | .80 | 132.1 | .81 | 132.6 | .81 | 133.1 | .81 | 133.5 | .82 | 1160 | |
| 120.2 | .68 | 120.7 | .68 | 121.2 | .68 | 121.7 | .69 | 122.1 | .69 | 122.6 | .69 | 123.1 | .70 | 123.5 | .70 | 123.9 | .70 | 124.4 | .71 | 124.8 | .71 | 125.3 | .71 | 125.7 | .72 | 1170 | |
| 113.5 | .60 | 114.0 | .60 | 114.4 | .61 | 114.9 | .61 | 115.3 | .62 | 115.7 | .62 | 116.2 | .62 | 116.6 | .63 | 117.0 | .63 | 117.5 | .63 | 117.9 | .63 | 118.3 | .63 | 118.7 | .64 | 1180 | |
| 107.5 | .54 | 108.0 | .54 | 108.4 | .54 | 108.8 | .54 | 109.2 | .55 | 109.6 | .55 | 110.1 | .55 | 110.5 | .55 | 110.9 | .55 | 111.3 | .56 | 111.7 | .56 | 112.0 | .57 | 112.4 | .57 | 1190 | |
| 102.2 | .47 | 102.6 | .48 | 103.0 | .48 | 103.4 | .48 | 103.8 | .49 | 104.2 | .49 | 104.6 | .49 | 105.0 | .49 | 105.3 | .49 | 105.7 | .50 | 106.1 | .50 | 106.5 | .50 | 106.8 | .51 | 1200 | |
| 97.29 | .43 | 97.70 | .43 | 98.10 | .43 | 98.49 | .43 | 98.87 | .44 | 99.24 | .44 | 99.61 | .44 | 99.98 | .44 | 100.3 | .44 | 100.7 | .45 | 101.0 | .45 | 101.4 | .45 | 101.7 | .46 | 1210 | |
| 92.87 | .387 | 93.26 | .389 | 93.64 | .391 | 94.01 | .393 | 94.37 | .395 | 94.73 | .397 | 95.08 | .399 | 95.43 | .401 | 95.77 | .403 | 96.11 | .41 | 96.45 | .41 | 96.78 | .41 | 97.10 | .41 | 1220 | |
| 88.83 | .351 | 89.20 | .353 | 89.56 | .355 | 89.92 | .357 | 90.27 | .359 | 90.61 | .361 | 90.95 | .363 | 91.28 | .365 | 91.61 | .367 | 91.94 | .369 | 92.26 | .371 | 92.57 | .373 | 92.88 | .375 | 1230 | |
| 85.13 | .320 | 85.48 | .322 | 85.83 | .324 | 86.17 | .326 | 86.50 | .328 | 86.82 | .330 | 87.15 | .332 | 87.47 | .333 | 87.79 | .335 | 88.10 | .337 | 88.41 | .339 | 88.71 | .341 | 89.00 | .343 | 1240 | |
| 81.73 | .291 | 82.07 | .293 | 82.40 | .295 | 82.73 | .297 | 83.05 | .299 | 83.36 | .300 | 83.67 | .302 | 83.98 | .304 | 84.28 | .306 | 84.58 | .308 | 84.88 | .309 | 85.17 | .310 | 85.45 | .312 | 1250 | |
| 78.57 | .269 | 78.90 | .271 | 79.22 | .273 | 79.54 | .274 | 79.84 | .276 | 80.13 | .278 | 80.44 | .279 | 80.74 | .281 | 81.02 | .282 | 81.32 | .284 | 81.60 | .285 | 81.88 | .286 | 82.15 | .287 | 1260 | |
| 75.67 | .247 | 75.98 | .249 | 76.28 | .251 | 76.58 | .252 | 76.88 | .254 | 77.16 | .255 | 77.46 | .256 | 77.75 | .257 | 78.02 | .259 | 78.31 | .260 | 78.58 | .261 | 78.85 | .262 | 79.10 | .263 | 1270 | |
| 72.95 | .228 | 73.26 | .229 | 73.56 | .230 | 73.85 | .232 | 74.13 | .233 | 74.41 | .234 | 74.69 | .236 | 74.96 | .237 | 75.23 | .238 | 75.50 | .239 | 75.77 | .241 | 76.03 | .242 | 76.28 | .243 | 1280 | |
| 70.45 | .210 | 70.74 | .211 | 71.02 | .213 | 71.31 | .214 | 71.58 | .215 | 71.85 | .216 | 72.12 | .217 | 72.38 | .218 | 72.64 | .219 | 72.91 | .221 | 73.17 | .222 | 73.42 | .223 | 73.66 | .224 | 1290 | |
| 68.11 | .195 | 68.39 | .196 | 68.66 | .197 | 68.94 | .199 | 69.20 | .200 | 69.46 | .201 | 69.73 | .202 | 69.98 | .203 | 70.23 | .204 | 70.48 | .206 | 70.73 | .207 | 70.97 | .208 | 71.20 | .209 | 1300 | |
| 65.90 | .182 | 66.17 | .183 | 66.44 | .184 | 66.71 | .186 | 66.96 | .187 | 67.21 | .188 | 67.46 | .189 | 67.71 | .190 | 67.95 | .191 | 68.20 | .192 | 68.44 | .193 | 68.67 | .194 | 68.90 | .195 | 1310 | |
| 63.85 | .167 | 64.12 | .168 | 64.38 | .169 | 64.64 | .171 | 64.88 | .172 | 65.12 | .173 | 65.37 | .174 | 65.61 | .175 | 65.84 | .176 | 66.08 | .177 | 66.31 | .178 | 66.54 | .179 | 66.76 | .180 | 1320 | |
| 61.91 | .158 | 62.17 | .159 | 62.42 | .160 | 62.67 | .161 | 62.91 | .162 | 63.14 | .163 | 63.39 | .164 | 63.62 | .165 | 63.84 | .166 | 64.08 | .167 | 64.30 | .168 | 64.52 | .169 | 64.73 | .170 | 1330 | |
| 60.09 | .147 | 60.34 | .148 | 60.58 | .149 | 60.83 | .150 | 61.05 | .151 | 61.28 | .152 | 61.51 | .152 | 61.74 | .153 | 61.96 | .154 | 62.19 | .155 | 62.41 | .156 | 62.62 | .157 | 62.82 | .158 | 1340 | |
| 58.37 | .137 | 58.61 | .138 | 58.85 | .139 | 59.09 | .140 | 59.31 | .141 | 59.53 | .142 | 59.76 | .142 | 59.98 | .143 | 60.19 | .144 | 60.41 | .145 | 60.62 | .146 | 60.83 | .147 | 61.02 | .148 | 1350 | |
| 56.75 | .128 | 56.99 | .129 | 57.22 | .130 | 57.45 | .131 | 57.66 | .132 | 57.88 | .133 | 58.10 | .133 | 58.31 | .134 | 58.52 | .135 | 58.73 | .136 | 58.94 | .137 | 59.14 | .138 | 59.33 | .139 | 1360 | |
| 55.22 | .122 | 55.45 | .123 | 55.67 | .123 | 55.89 | .124 | 56.10 | .125 | 56.31 | .126 | 56.53 | .127 | 56.73 | .128 | 56.93 | .128 | 57.14 | .129 | 57.34 | .129 | 57.54 | .130 | 57.73 | .130 | 1370 | |
| 53.76 | .114 | 53.99 | .115 | 54.20 | .116 | 54.42 | .116 | 54.63 | .117 | 54.83 | .118 | 55.04 | .119 | 55.24 | .120 | 55.44 | .120 | 55.64 | .121 | 55.83 | .122 | 56.02 | .123 | 56.21 | .123 | 1380 | |
| 52.38 | .108 | 52.60 | .109 | 52.81 | .109 | 53.02 | .110 | 53.22 | .111 | 53.42 | .111 | 53.63 | .112 | 53.83 | .113 | 54.02 | .113 | 54.21 | .114 | 54.40 | .114 | 54.59 | .115 | 54.77 | .115 | 1390 | |
| 51.07 | .102 | 51.29 | .103 | 51.49 | .103 | 51.70 | .104 | 51.89 | .105 | 52.08 | .105 | 52.28 | .106 | 52.48 | .107 | 52.66 | .107 | 52.86 | .108 | 53.04 | .108 | 53.22 | .109 | 53.40 | .109 | 1400 | |
| 49.83 | .095 | 50.04 | .096 | 50.24 | .096 | 50.44 | .097 | 50.63 | .098 | 50.82 | .098 | 51.01 | .099 | 51.20 | .100 | 51.38 | .100 | 51.57 | .101 | 51.75 | .101 | 51.93 | .102 | 52.10 | .102 | 1410 | |
| 48.65 | .090 | 48.85 | .091 | 49.05 | .091 | 49.25 | .092 | 49.43 | .093 | 49.61 | .093 | 49.81 | .094 | 49.99 | .095 | 50.16 | .095 | 50.34 | .096 | 50.52 | .096 | 50.70 | .097 | 50.87 | .097 | 1420 | |
| 47.51 | .086 | 47.71 | .087 | 47.90 | .087 | 48.10 | .088 | 48.29 | .089 | 48.46 | .089 | 48.64 | .090 | 48.82 | .091 | 48.99 | .091 | 49.17 | .092 | 49.34 | .092 | 49.51 | .093 | 49.67 | .093 | 1430 | |
| 46.43 | .081 | 46.62 | .082 | 46.81 | .082 | 47.00 | .083 | 47.18 | .084 | 47.35 | .084 | 47.53 | .085 | 47.70 | .086 | 47.87 | .086 | 48.05 | .087 | 48.22 | .087 | 48.38 | .088 | 48.54 | .088 | 1440 | |
| 45.40 | .075 | 45.59 | .076 | 45.78 | .077 | 45.96 | .078 | 46.13 | .079 | 46.30 | .079 | 46.48 | .080 | 46.65 | .081 | 46.81 | .081 | 46.98 | .082 | 47.15 | .082 | 47.31 | .083 | 47.47 | .083 | 1450 | |
| 44.41 | .074 | 44.59 | .074 | 44.77 | .075 | 44.95 | .075 | 45.12 | .076 | 45.29 | .077 | 45.46 | .077 | 45.63 | .078 | 45.79 | .078 | 45.96 | .079 | 46.12 | .079 | 46.28 | .080 | 46.43 | .080 | 1460 | |
| 43.47 | .069 | 43.65 | .069 | 43.82 | .070 | 44.00 | .071 | 44.17 | .071 | 44.33 | .072 | 44.50 | .072 | 44.66 | .073 | 44.82 | .073 | 44.98 | .074 | 45.14 | .074 | 45.30 | .075 | 45.45 | .075 | 1470 | |
| 42.57 | .066 | 42.75 | .066 | 42.91 | .067 | 43.09 | .067 | 43.25 | .068 | 43.41 | .069 | 43.58 | .069 | 43.74 | .070 | 43.89 | .070 | 44.06 | .070 | 44.21 | .071 | 44.36 | .071 | 44.50 | .071 | 1480 | |
| 41.70 | .064 | 41.87 | .065 | 42.03 | .065 | 42.21 | .065 | 42.36 | .066 | 42.52 | .066 | 42.69 | .066 | 42.84 | .067 | 42.99 | .067 | 43.15 | .067 | 43.30 | .069 | 43.45 | .069 | 43.59 | .069 | 1490 | |
| 40.86 | .060 | 41.03 | .060 | 41.19 | .061 | 41.36 | .061 | 41.52 | .062 | 41.67 | .062 | 41.83 | .062 | 41.99 | .063 | 42.14 | .063 | 42.29 | .064 | 42.43 | .064 | 42.58 | .065 | 42.72 | .066 | 1500 | |

Weight in Grams of One Liter of Wet Pulp

TABLE IV-A. LOGARITHMS OF NUMBER OF CUBIC FEET OF WET PULP TO MAKE ONE TON OF DRY SLIME—Continued

Specific Gravity of Dry Slime

| 2.76 | Correction | 2.78 | Correction | 2.80 | Correction | 2.82 | Correction | 2.84 | Correction | 2.86 | Correction | 2.88 | Correction | 2.90 | Correction | 2.92 | Correction | 2.94 | Correction | 2.96 | Correction | 2.98 | Correction | 3.00 | Correction | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .3103 | | .3122 | | .3139 | | .3156 | | .3172 | | .3189 | | .3206 | | .3220 | | .3237 | | .3253 | | .3267 | | .3282 | | .3296 | | 1010 | |
| .0094 | 100.9 | .0111 | 101.4 | .0128 | 101.8 | .0145 | 102.3 | .0162 | 102.7 | .0179 | 103.1 | .0195 | 103.5 | .0212 | 103.9 | .0224 | 104.3 | .0241 | 104.7 | .0257 | 105.0 | .0273 | 105.4 | .0286 | 105.8 | 1020 | |
| .8332 | 33.5 | .8350 | 33.6 | .8367 | 33.7 | .8385 | 33.9 | .8401 | 34.1 | .8417 | 34.2 | .8434 | 34.3 | .8450 | 34.4 | .8465 | 34.5 | .8481 | 34.7 | .8496 | 34.8 | .8511 | 34.9 | .8525 | 35.1 | 1030 | |
| .7082 | 16.65 | .7100 | 16.72 | .7117 | 16.79 | .7134 | 16.87 | .7151 | 16.94 | .7168 | 17.00 | .7184 | 17.07 | .7200 | 17.14 | .7216 | 17.21 | .7231 | 17.27 | .7246 | 17.33 | .7261 | 17.39 | .7275 | 17.46 | 1040 | |
| .6113 | 9.92 | .6131 | 9.97 | .6148 | 10.02 | .6165 | 10.07 | .6182 | 10.11 | .6198 | 10.14 | .6215 | 10.18 | .6231 | 10.22 | .6247 | 10.26 | .6262 | 10.30 | .6278 | 10.34 | .6292 | 10.38 | .6306 | 10.42 | 1050 | |
| .5321 | 6.58 | .5339 | 6.61 | .5355 | 6.64 | .5373 | 6.67 | .5390 | 6.70 | .5406 | 6.73 | .5423 | 6.75 | .5439 | 6.77 | .5454 | 6.80 | .5470 | 6.83 | .5485 | 6.86 | .5500 | 6.88 | .5514 | 6.91 | 1060 | |
| .4652 | 4.66 | .4670 | 4.68 | .4688 | 4.70 | .4706 | 4.72 | .4722 | 4.75 | .4738 | 4.77 | .4754 | 4.79 | .4770 | 4.81 | .4786 | 4.83 | .4802 | 4.85 | .4816 | 4.87 | .4832 | 4.88 | .4846 | 4.90 | 1070 | |
| .4072 | 3.48 | .4089 | 3.50 | .4108 | 3.51 | .4125 | 3.53 | .4141 | 3.55 | .4158 | 3.56 | .4175 | 3.58 | .4190 | 3.59 | .4205 | 3.61 | .4221 | 3.62 | .4236 | 3.64 | .4250 | 3.65 | .4265 | 3.67 | 1080 | |
| .3560 | 2.69 | .3579 | 2.70 | .3596 | 2.71 | .3614 | 2.72 | .3630 | 2.74 | .3646 | 2.76 | .3662 | 2.77 | .3679 | 2.78 | .3694 | 2.79 | .3711 | 2.80 | .3725 | 2.81 | .3740 | 2.82 | .3755 | 2.83 | 1090 | |
| .3103 | 2.14 | .3122 | 2.15 | .3139 | 2.16 | .3156 | 2.17 | .3172 | 2.18 | .3189 | 2.19 | .3206 | 2.20 | .3220 | 2.21 | .3237 | 2.22 | .3251 | 2.23 | .3267 | 2.24 | .3282 | 2.25 | .3296 | 2.26 | 1100 | |
| .2688 | 1.74 | .2707 | 1.75 | .2723 | 1.76 | .2742 | 1.77 | .2758 | 1.78 | .2774 | 1.79 | .2792 | 1.79 | .2808 | 1.80 | .2822 | 1.81 | .2838 | 1.82 | .2853 | 1.82 | .2869 | 1.82 | .2882 | 1.83 | 1110 | |
| .2312 | 1.44 | .2330 | 1.45 | .2345 | 1.46 | .2363 | 1.47 | .2378 | 1.48 | .2395 | 1.48 | .2413 | 1.49 | .2428 | 1.49 | .2445 | 1.49 | .2460 | 1.50 | .2475 | 1.51 | .2491 | 1.52 | .2504 | 1.52 | 1120 | |
| .1965 | 1.21 | .1981 | 1.21 | .2000 | 1.22 | .2017 | 1.23 | .2033 | 1.24 | .2049 | 1.24 | .2066 | 1.24 | .2082 | 1.25 | .2098 | 1.25 | .2114 | 1.26 | .2127 | 1.26 | .2143 | 1.29 | .2156 | 1.28 | 1130 | |
| .1641 | 1.04 | .1658 | 1.04 | .1676 | 1.05 | .1694 | 1.05 | .1711 | 1.06 | .1726 | 1.06 | .1744 | 1.06 | .1761 | 1.07 | .1775 | 1.07 | .1790 | 1.08 | .1807 | 1.08 | .1821 | 1.09 | .1836 | 1.09 | 1140 | |
| .1342 | .89 | .1358 | .90 | .1377 | .90 | .1396 | .90 | .1411 | .91 | .1427 | .91 | .1443 | .92 | .1458 | .93 | .1474 | .93 | .1489 | .94 | .1504 | .94 | .1520 | .94 | .1535 | .94 | 1150 | |
| .1062 | .77 | .1079 | .78 | .1096 | .79 | .1113 | .79 | .1129 | .80 | .1146 | .80 | .1163 | .80 | .1179 | .80 | .1196 | .80 | .1209 | .81 | .1225 | .81 | .1242 | .81 | .1255 | .82 | 1160 | |
| .0799 | .68 | .0817 | .68 | .0835 | .68 | .0853 | .69 | .0867 | .69 | .0885 | .69 | .0903 | .70 | .0917 | .70 | .0931 | .71 | .0948 | .71 | .0962 | .71 | .0980 | .71 | .0993 | .72 | 1170 | |
| .0550 | .60 | .0569 | .60 | .0584 | .61 | .0603 | .61 | .0618 | .62 | .0633 | .62 | .0652 | .62 | .0667 | .63 | .0682 | .63 | .0700 | .63 | .0715 | .63 | .0730 | .63 | .0745 | .64 | 1180 | |
| .0314 | .54 | .0334 | .54 | .0350 | .54 | .0366 | .54 | .0382 | .55 | .0398 | .55 | .0418 | .55 | .0434 | .55 | .0449 | .55 | .0465 | .56 | .0481 | .56 | .0492 | .57 | .0508 | .57 | 1190 | |
| .0095 | .47 | .0111 | .48 | .0128 | .48 | .0145 | .48 | .0162 | .49 | .0179 | .49 | .0195 | .49 | .0212 | .49 | .0224 | .49 | .0241 | .50 | .0257 | .50 | .0273 | .50 | .0286 | .51 | 1200 | |
| .9881 | .43 | .9899 | .43 | .9917 | .43 | .9934 | .43 | .9951 | .44 | .9967 | .44 | .9983 | .44 | .9999 | .44 | .0013 | .44 | .0030 | .45 | .0043 | .45 | .0060 | .45 | .0073 | .46 | 1210 | |
| .9679 | .387 | .9697 | .389 | .9715 | .391 | .9732 | .393 | .9748 | .395 | .9765 | .397 | .9781 | .399 | .9797 | .401 | .9812 | .403 | .9828 | .41 | .9843 | .41 | .9858 | .41 | .9872 | .41 | 1220 | |
| .9486 | .351 | .9504 | .353 | .9521 | .355 | .9539 | .357 | .9555 | .359 | .9572 | .361 | .9588 | .363 | .9604 | .365 | .9619 | .367 | .9635 | .369 | .9650 | .371 | .9665 | .373 | .9679 | .375 | 1230 | |
| .9301 | .320 | .9319 | .322 | .9336 | .324 | .9354 | .326 | .9370 | .328 | .9386 | .330 | .9403 | .332 | .9419 | .333 | .9434 | .335 | .9450 | .337 | .9465 | .339 | .9480 | .341 | .9494 | .343 | 1240 | |
| .9124 | .291 | .9142 | .293 | .9159 | .295 | .9177 | .297 | .9193 | .299 | .9210 | .300 | .9226 | .302 | .9242 | .304 | .9257 | .306 | .9273 | .308 | .9288 | .309 | .9303 | .310 | .9317 | .312 | 1250 | |
| .8953 | .269 | .8971 | .271 | .8988 | .273 | .9006 | .274 | .9022 | .276 | .9038 | .278 | .9055 | .279 | .9071 | .281 | .9086 | .282 | .9102 | .284 | .9117 | .285 | .9132 | .286 | .9146 | .287 | 1260 | |
| .8789 | .247 | .8807 | .249 | .8824 | .251 | .8841 | .252 | .8858 | .254 | .8874 | .255 | .8891 | .256 | .8907 | .257 | .8922 | .259 | .8938 | .260 | .8953 | .261 | .8968 | .262 | .8982 | .263 | 1270 | |
| .8630 | .228 | .8649 | .229 | .8666 | .230 | .8684 | .232 | .8700 | .233 | .8716 | .234 | .8733 | .236 | .8748 | .237 | .8764 | .238 | .8779 | .239 | .8795 | .241 | .8810 | .242 | .8824 | .243 | 1280 | |
| .8479 | .210 | .8497 | .211 | .8514 | .213 | .8532 | .214 | .8548 | .215 | .8564 | .216 | .8581 | .217 | .8596 | .218 | .8612 | .219 | .8628 | .221 | .8643 | .222 | .8658 | .223 | .8672 | .224 | 1290 | |
| .8332 | .195 | .8350 | .196 | .8367 | .197 | .8385 | .199 | .8401 | .200 | .8417 | .201 | .8434 | .202 | .8450 | .203 | .8465 | .204 | .8481 | .206 | .8496 | .207 | .8511 | .208 | .8525 | .209 | 1300 | |
| .8189 | .182 | .8207 | .183 | .8224 | .184 | .8242 | .186 | .8258 | .187 | .8274 | .188 | .8290 | .189 | .8307 | .190 | .8322 | .191 | .8338 | .192 | .8353 | .193 | .8368 | .194 | .8382 | .195 | 1310 | |
| .8052 | .167 | .8070 | .168 | .8088 | .169 | .8105 | .171 | .8121 | .172 | .8137 | .173 | .8154 | .174 | .8170 | .175 | .8185 | .176 | .8201 | .177 | .8216 | .178 | .8231 | .179 | .8245 | .180 | 1320 | |
| .7919 | .158 | .7936 | .159 | .7953 | .160 | .7971 | .161 | .7987 | .162 | .8003 | .163 | .8020 | .164 | .8036 | .165 | .8051 | .166 | .8067 | .167 | .8082 | .168 | .8097 | .169 | .8111 | .170 | 1330 | |
| .7788 | .147 | .7806 | .148 | .7823 | .149 | .7841 | .150 | .7857 | .151 | .7873 | .152 | .7889 | .152 | .7906 | .153 | .7924 | .154 | .7977 | .155 | .7952 | .156 | .7967 | .157 | .7981 | .158 | 1340 | |
| .7662 | .137 | .7680 | .138 | .7697 | .139 | .7715 | .140 | .7731 | .141 | .7747 | .142 | .7764 | .142 | .7780 | .143 | .7795 | .144 | .7811 | .145 | .7826 | .146 | .7841 | .147 | .7855 | .148 | 1350 | |
| .7540 | .128 | .7558 | .129 | .7575 | .130 | .7593 | .131 | .7609 | .132 | .7625 | .133 | .7642 | .133 | .7657 | .134 | .7673 | .135 | .7689 | .136 | .7704 | .137 | .7719 | .138 | .7733 | .139 | 1360 | |
| .7421 | .122 | .7439 | .123 | .7456 | .123 | .7473 | .124 | .7490 | .125 | .7506 | .126 | .7523 | .127 | .7538 | .128 | .7553 | .128 | .7569 | .129 | .7585 | .129 | .7600 | .130 | .7614 | .130 | 1370 | |
| .7305 | .114 | .7323 | .115 | .7340 | .116 | .7358 | .116 | .7374 | .117 | .7390 | .118 | .7407 | .119 | .7422 | .120 | .7438 | .120 | .7454 | .121 | .7469 | .122 | .7483 | .123 | .7498 | .123 | 1380 | |
| .7192 | .103 | .7210 | .109 | .7227 | .109 | .7244 | .110 | .7261 | .111 | .7277 | .111 | .7294 | .112 | .7310 | .113 | .7326 | .113 | .7341 | .114 | .7356 | .114 | .7371 | .115 | .7385 | .115 | 1390 | |
| .7082 | .102 | .7100 | .103 | .7117 | .103 | .7135 | .104 | .7151 | .105 | .7167 | .105 | .7183 | .106 | .7200 | .107 | .7215 | .017 | .7231 | .108 | .7246 | .108 | .7261 | .109 | .7275 | .109 | 1400 | |
| .6975 | .095 | .6993 | .096 | .7010 | .096 | .7028 | .097 | .7044 | .098 | .7060 | .098 | .7077 | .099 | .7093 | .100 | .7108 | .100 | .7124 | .101 | .7139 | .101 | .7154 | .102 | .7168 | .102 | 1410 | |
| .6871 | .090 | .6889 | .091 | .6906 | .091 | .6924 | .092 | .6940 | .093 | .6956 | .093 | .6973 | .094 | .6989 | .095 | .7004 | .095 | .7020 | .096 | .7035 | .096 | .7050 | .097 | .7065 | .097 | 1420 | |
| .6768 | .086 | .6786 | .087 | .6803 | .087 | .6821 | .088 | .6839 | .089 | .6854 | .089 | .6870 | .090 | .6886 | .091 | .6901 | .091 | .6917 | .092 | .6932 | .092 | .6947 | .093 | .6961 | .093 | 1430 | |
| .6668 | .081 | .6686 | .082 | .6703 | .082 | .6721 | .083 | .6738 | .084 | .6753 | .084 | .6770 | .085 | .6785 | .086 | .6801 | .086 | .6817 | .087 | .6832 | .087 | .6847 | .088 | .6861 | .088 | 1440 | |
| .6571 | .075 | .6589 | .076 | .6607 | .077 | .6624 | .078 | .6640 | .079 | .6656 | .079 | .6673 | .080 | .6689 | .081 | .6703 | .081 | .6719 | .082 | .6735 | .082 | .6750 | .083 | .6764 | .083 | 1450 | |
| .6475 | .074 | .6493 | .074 | .6510 | .075 | .6527 | .075 | .6544 | .076 | .6560 | .077 | .6576 | .077 | .6592 | .078 | .6608 | .078 | .6624 | .079 | .6639 | .079 | .6654 | .080 | .6668 | .080 | 1460 | |
| .6382 | .069 | .6400 | .069 | .6417 | .070 | .6434 | .071 | .6451 | .071 | .6467 | .072 | .6484 | .072 | .6499 | .073 | .6515 | .073 | .6530 | .074 | .6546 | .074 | .6561 | .075 | .6575 | .075 | 1470 | |
| .6291 | .066 | .6309 | .066 | .6326 | .067 | .6344 | .067 | .6360 | .068 | .6376 | .069 | .6393 | .069 | .6409 | .070 | .6424 | .070 | .6440 | .070 | .6455 | .071 | .6470 | .071 | .6484 | .071 | 1480 | |
| .6201 | .064 | .6219 | .065 | .6236 | .065 | .6254 | .065 | .6270 | .066 | .6286 | .066 | .6303 | .066 | .6318 | .067 | .6334 | .067 | .6350 | .067 | .6365 | .069 | .6380 | .069 | .6394 | .069 | 1490 | |
| .6113 | .060 | .6131 | .060 | .6148 | .061 | .6166 | .061 | .6183 | .062 | .6198 | .062 | .6215 | .062 | .6251 | .063 | .6247 | .033 | .6262 | .064 | .6277 | .064 | .6292 | .065 | .6306 | .066 | 1500 | |

Weight in Grams of One Liter of Wet Pulp

merged in the tank, such as agitating gear, decanting pipes, etc.

The following example will illustrate the use of Table 4 in connection with Table 6 in calculating the number of tons of dry slime in a charge of pulp 10 ft. in depth, contained in a tank 30 ft. 6 in. in diameter. Given:

NOTE—The characteristics of these logarithms are best found by looking at the natural numbers corresponding to them, and calculating from the numbers, as in ordinary logarithmic work. They are 3, 2 or 1, and the change is apparent from the change in mantissa, so that after experience with the table, they can be determined by inspection.

The specific gravity of the dry slime 2.66; the weight of one liter of pulp 1150 grams; the specific gravity of solution 1.005. Required: The number of tons of dry slime in the charge. In Table 4, at the intersection of the vertical column headed 2.66 and the horizontal column headed 1150, is found 133.3, the number of cubic feet of pulp to make one ton of dry slime when the headed 30 ft. and the horizontal column headed 6 in., is found 730.6, the number of cubic feet per foot of depth for a tank 30 ft. 6 in. in diameter; $730.6 \times 10 = 7306$, apparent total cubic feet of pulp in the tank. Suppose 5.5 cu.ft. are occupied in the tank by various devices below the pulp level; $7306 - 5.5 = 7300.5$, actual cubic feet of pulp in the tank; $7300.5 \div 137.03 =$

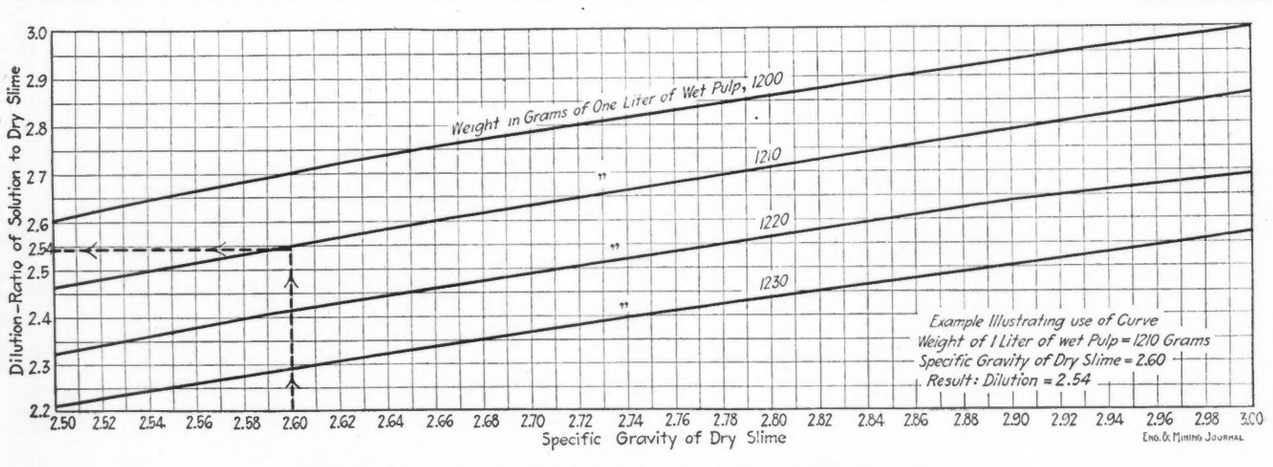
TABLE V. DILUTION—RATIO OF SOLUTION TO DRY SLIME

Formula: $$\frac{64.42\,a - 64.42\,a\,\frac{P}{100}}{64.42\,a\,\frac{P}{100}}$$

Specific Gravity of Dry Slime

| Weight in Grams of One Liter of Wet Pulp | 2.50 | 2.52 | 2.54 | 2.56 | 2.58 | 2.60 | 2.62 | 2.64 | 2.66 | 2.68 | 2.70 | 2.72 | 2.74 | 2.76 | 2.78 | 2.80 | 2.82 | 2.84 | 2.86 | 2.88 | 2.90 | 2.92 | 2.94 | 2.96 | 2.98 | 3.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | 59.6 | 60.0 | 60.3 | 60.6 | 60.9 | 61.2 | 61.5 | 61.8 | 62.0 | 62.3 | 62.6 | 62.9 | 63.2 | 63.5 | 63.7 | 63.9 | 64.2 | 65.4 | 64.7 | 65.0 | 65.3 | 65.5 | 65.7 | 66.0 | 66.2 | 66.4 |
| 1020 | 29.6 | 29.8 | 29.9 | 30.1 | 30.2 | 30.4 | 30.5 | 30.7 | 30.8 | 31.0 | 31.1 | 31.3 | 31.4 | 31.5 | 31.6 | 31.8 | 31.9 | 32.0 | 32.2 | 32.3 | 32.4 | 32.5 | 32.6 | 32.8 | 32.9 | 33.0 |
| 1030 | 19.6 | 19.7 | 19.8 | 19.9 | 20.0 | 20.1 | 20.2 | 20.3 | 20.4 | 20.5 | 20.6 | 20.7 | 20.8 | 20.9 | 21.0 | 21.0 | 21.1 | 21.2 | 21.3 | 21.4 | 21.5 | 21.5 | 21.6 | 21.7 | 21.8 | 21.9 |
| 1040 | 14.6 | 14.7 | 14.8 | 14.8 | 14.9 | 15.0 | 15.0 | 15.1 | 15.2 | 15.3 | 15.4 | 15.4 | 15.5 | 15.6 | 15.6 | 15.7 | 15.8 | 15.8 | 15.9 | 15.9 | 16.0 | 16.1 | 16.1 | 16.2 | 16.3 | 16.3 |
| 1050 | 11.6 | 11.7 | 11.8 | 11.8 | 11.9 | 11.9 | 12.0 | 12.0 | 12.1 | 12.1 | 12.2 | 12.3 | 12.3 | 12.4 | 12.4 | 12.5 | 12.6 | 12.6 | 12.7 | 12.7 | 12.8 | 12.8 | 12.9 | 12.9 | 13.0 | 13.0 |
| 1060 | 9.60 | 9.67 | 9.72 | 9.77 | 9.82 | 9.87 | 9.92 | 9.97 | 10.0 | 10.1 | 10.1 | 10.2 | 10.2 | 10.3 | 10.3 | 10.4 | 10.4 | 10.5 | 10.5 | 10.5 | 10.6 | 10.6 | 10.7 | 10.7 | 10.8 | 10.8 |
| 1070 | 8.18 | 8.23 | 8.27 | 8.32 | 8.37 | 8.41 | 8.45 | 8.50 | 8.54 | 8.58 | 8.62 | 8.66 | 8.71 | 8.75 | 8.79 | 8.83 | 8.87 | 8.90 | 8.94 | 8.98 | 9.01 | 9.05 | 9.08 | 9.12 | 9.16 | 9.19 |
| 1080 | 7.10 | 7.14 | 7.18 | 7.22 | 7.25 | 7.30 | 7.34 | 7.38 | 7.42 | 7.46 | 7.49 | 7.53 | 7.57 | 7.61 | 7.64 | 7.68 | 7.71 | 7.75 | 7.78 | 7.81 | 7.85 | 7.88 | 7.91 | 7.94 | 7.97 | 8.00 |
| 1090 | 6.27 | 6.31 | 6.34 | 6.38 | 6.42 | 6.46 | 6.49 | 6.53 | 6.56 | 6.60 | 6.63 | 6.66 | 6.69 | 6.73 | 6.76 | 6.79 | 6.82 | 6.85 | 6.88 | 6.91 | 6.94 | 6.97 | 7.00 | 7.03 | 7.05 | 7.08 |
| 1100 | 5.55 | 5.60 | 5.65 | 5.70 | 5.74 | 5.77 | 5.81 | 5.84 | 5.87 | 5.90 | 5.93 | 5.96 | 5.99 | 6.02 | 6.04 | 6.07 | 6.10 | 6.13 | 6.16 | 6.18 | 6.21 | 6.23 | 6.26 | 6.28 | 6.31 | 6.34 |
| 1110 | 5.05 | 5.09 | 5.12 | 5.16 | 5.19 | 5.22 | 5.25 | 5.28 | 5.30 | 5.33 | 5.36 | 5.38 | 5.41 | 5.44 | 5.47 | 5.49 | 5.52 | 5.54 | 5.57 | 5.60 | 5.62 | 5.64 | 5.66 | 5.68 | 5.70 | 5.72 |
| 1120 | 4.59 | 4.62 | 4.65 | 4.68 | 4.71 | 4.74 | 4.77 | 4.80 | 4.83 | 4.86 | 4.88 | 4.91 | 4.93 | 4.96 | 4.99 | 5.01 | 5.03 | 5.06 | 5.08 | 5.10 | 5.12 | 5.14 | 5.16 | 5.18 | 5.20 | 5.22 |
| 1130 | 4.22 | 4.25 | 4.28 | 4.30 | 4.33 | 4.35 | 4.38 | 4.40 | 4.43 | 4.45 | 4.47 | 4.49 | 4.52 | 4.55 | 4.57 | 4.59 | 4.61 | 4.63 | 4.65 | 4.67 | 4.70 | 4.72 | 4.74 | 4.76 | 4.78 | 4.80 |
| 1140 | 3.89 | 3.91 | 3.94 | 3.96 | 3.99 | 4.01 | 4.04 | 4.06 | 4.09 | 4.11 | 4.13 | 4.16 | 4.18 | 4.20 | 4.22 | 4.24 | 4.26 | 4.28 | 4.30 | 4.32 | 4.34 | 4.36 | 4.38 | 4.40 | 4.41 | 4.42 |
| 1150 | 3.60 | 3.63 | 3.66 | 3.68 | 3.70 | 3.72 | 3.74 | 3.76 | 3.79 | 3.81 | 3.83 | 3.85 | 3.87 | 3.89 | 3.91 | 3.93 | 3.95 | 3.97 | 3.99 | 4.01 | 4.02 | 4.04 | 4.05 | 4.07 | 4.09 | 4.11 |
| 1160 | 3.34 | 3.37 | 3.40 | 3.42 | 3.44 | 3.46 | 3.48 | 3.50 | 3.52 | 3.54 | 3.56 | 3.58 | 3.60 | 3.62 | 3.64 | 3.66 | 3.68 | 3.70 | 3.72 | 3.73 | 3.75 | 3.77 | 3.79 | 3.80 | 3.81 | 3.83 |
| 1170 | 3.13 | 3.15 | 3.18 | 3.20 | 3.22 | 3.24 | 3.26 | 3.28 | 3.30 | 3.32 | 3.33 | 3.35 | 3.37 | 3.39 | 3.40 | 3.42 | 3.44 | 3.46 | 3.48 | 3.49 | 3.51 | 3.53 | 3.54 | 3.56 | 3.58 | 3.59 |
| 1180 | 2.93 | 2.95 | 2.97 | 2.99 | 3.01 | 3.03 | 3.05 | 3.07 | 3.09 | 3.11 | 3.13 | 3.14 | 3.16 | 3.18 | 3.20 | 3.22 | 3.23 | 3.25 | 3.26 | 3.27 | 3.29 | 3.31 | 3.33 | 3.34 | 3.36 | 3.37 |
| 1190 | 2.75 | 2.77 | 2.79 | 2.81 | 2.83 | 2.85 | 2.87 | 2.89 | 2.91 | 2.93 | 2.94 | 2.96 | 2.98 | 3.00 | 3.01 | 3.03 | 3.04 | 3.06 | 3.07 | 3.08 | 3.10 | 3.11 | 3.13 | 3.14 | 3.16 | 3.17 |
| 1200 | 2.60 | 2.62 | 2.64 | 2.66 | 2.68 | 2.70 | 2.72 | 2.73 | 2.75 | 2.77 | 2.78 | 2.80 | 2.81 | 2.83 | 2.84 | 2.86 | 2.87 | 2.89 | 2.90 | 2.92 | 2.93 | 2.95 | 2.96 | 2.98 | 2.99 | 3.00 |
| 1210 | 2.46 | 2.48 | 2.50 | 2.51 | 2.53 | 2.54 | 2.56 | 2.58 | 2.60 | 2.61 | 2.63 | 2.64 | 2.66 | 2.67 | 2.69 | 2.70 | 2.72 | 2.73 | 2.75 | 2.76 | 2.78 | 2.80 | 2.81 | 2.83 | 2.85 | 2.86 |
| 1220 | 2.32 | 2.34 | 2.36 | 2.37 | 2.39 | 2.41 | 2.43 | 2.44 | 2.46 | 2.47 | 2.49 | 2.50 | 2.52 | 2.53 | 2.55 | 2.56 | 2.58 | 2.59 | 2.61 | 2.62 | 2.64 | 2.65 | 2.66 | 2.67 | 2.68 | 2.69 |
| 1230 | 2.21 | 2.23 | 2.24 | 2.26 | 2.27 | 2.29 | 2.30 | 2.32 | 2.33 | 2.35 | 2.37 | 2.38 | 2.39 | 2.41 | 2.42 | 2.43 | 2.45 | 2.46 | 2.47 | 2.49 | 2.50 | 2.51 | 2.53 | 2.54 | 2.55 | 2.57 |
| 1240 | 2.09 | 2.11 | 2.13 | 2.14 | 2.16 | 2.17 | 2.19 | 2.21 | 2.22 | 2.24 | 2.25 | 2.27 | 2.28 | 2.29 | 2.30 | 2.31 | 2.33 | 2.34 | 2.35 | 2.37 | 2.38 | 2.39 | 2.40 | 2.42 | 2.43 | 2.44 |
| 1250 | 2.00 | 2.01 | 2.03 | 2.05 | 2.06 | 2.08 | 2.09 | 2.11 | 2.12 | 2.14 | 2.15 | 2.17 | 2.18 | 2.20 | 2.21 | 2.22 | 2.23 | 2.24 | 2.25 | 2.26 | 2.27 | 2.29 | 2.30 | 2.31 | 2.32 | 2.33 |
| 1260 | 1.91 | 1.92 | 1.94 | 1.95 | 1.97 | 1.98 | 2.00 | 2.01 | 2.03 | 2.04 | 2.05 | 2.06 | 2.08 | 2.09 | 2.10 | 2.11 | 2.13 | 2.14 | 2.15 | 2.16 | 2.17 | 2.18 | 2.20 | 2.21 | 2.22 | 2.23 |
| 1270 | 1.83 | 1.84 | 1.86 | 1.87 | 1.88 | 1.89 | 1.91 | 1.92 | 1.94 | 1.95 | 1.96 | 1.97 | 1.99 | 2.00 | 2.01 | 2.02 | 2.03 | 2.05 | 2.06 | 2.07 | 2.08 | 2.09 | 2.10 | 2.11 | 2.12 | 2.13 |
| 1280 | 1.75 | 1.76 | 1.77 | 1.79 | 1.80 | 1.81 | 1.83 | 1.84 | 1.85 | 1.86 | 1.87 | 1.88 | 1.89 | 1.91 | 1.93 | 1.94 | 1.95 | 1.96 | 1.97 | 1.98 | 2.00 | 2.01 | 2.02 | 2.03 | 2.04 | 2.05 |
| 1290 | 1.68 | 1.69 | 1.70 | 1.71 | 1.72 | 1.74 | 1.75 | 1.76 | 1.78 | 1.79 | 1.80 | 1.81 | 1.82 | 1.84 | 1.85 | 1.86 | 1.87 | 1.88 | 1.89 | 1.90 | 1.91 | 1.92 | 1.94 | 1.95 | 1.96 | 1.97 |
| 1300 | 1.63 | 1.61 | 1.63 | 1.64 | 1.66 | 1.67 | 1.68 | 1.69 | 1.71 | 1.72 | 1.73 | 1.74 | 1.75 | 1.77 | 1.78 | 1.79 | 1.80 | 1.81 | 1.82 | 1.83 | 1.84 | 1.85 | 1.86 | 1.87 | 1.88 | 1.89 |
| 1310 | 1.54 | 1.55 | 1.56 | 1.57 | 1.59 | 1.60 | 1.61 | 1.62 | 1.64 | 1.65 | 1.66 | 1.67 | 1.68 | 1.69 | 1.70 | 1.72 | 1.73 | 1.74 | 1.75 | 1.76 | 1.77 | 1.78 | 1.79 | 1.80 | 1.81 | 1.82 |
| 1320 | 1.48 | 1.49 | 1.50 | 1.52 | 1.53 | 1.54 | 1.55 | 1.56 | 1.58 | 1.59 | 1.60 | 1.61 | 1.62 | 1.63 | 1.64 | 1.65 | 1.66 | 1.67 | 1.68 | 1.69 | 1.70 | 1.71 | 1.72 | 1.73 | 1.74 | 1.75 |
| 1330 | 1.42 | 1.43 | 1.45 | 1.45 | 1.47 | 1.48 | 1.49 | 1.50 | 1.52 | 1.53 | 1.54 | 1.55 | 1.56 | 1.57 | 1.58 | 1.59 | 1.60 | 1.61 | 1.62 | 1.63 | 1.64 | 1.65 | 1.66 | 1.67 | 1.68 | 1.69 |
| 1340 | 1.37 | 1.38 | 1.39 | 1.40 | 1.41 | 1.43 | 1.44 | 1.45 | 1.46 | 1.47 | 1.48 | 1.49 | 1.50 | 1.51 | 1.52 | 1.53 | 1.54 | 1.55 | 1.56 | 1.57 | 1.58 | 1.59 | 1.60 | 1.61 | 1.62 | 1.63 |
| 1350 | 1.31 | 1.33 | 1.34 | 1.35 | 1.36 | 1.38 | 1.39 | 1.40 | 1.41 | 1.42 | 1.43 | 1.44 | 1.45 | 1.46 | 1.47 | 1.48 | 1.49 | 1.50 | 1.51 | 1.52 | 1.53 | 1.54 | 1.55 | 1.55 | 1.56 | 1.57 |
| 1360 | 1.27 | 1.28 | 1.29 | 1.30 | 1.31 | 1.32 | 1.34 | 1.35 | 1.36 | 1.37 | 1.38 | 1.39 | 1.40 | 1.41 | 1.42 | 1.43 | 1.44 | 1.45 | 1.46 | 1.47 | 1.48 | 1.48 | 1.49 | 1.50 | 1.51 | 1.52 |
| 1370 | 1.22 | 1.23 | 1.24 | 1.25 | 1.26 | 1.28 | 1.29 | 1.30 | 1.31 | 1.32 | 1.33 | 1.34 | 1.35 | 1.36 | 1.37 | 1.38 | 1.39 | 1.40 | 1.41 | 1.42 | 1.43 | 1.43 | 1.44 | 1.45 | 1.46 | 1.47 |
| 1380 | 1.18 | 1.19 | 1.20 | 1.21 | 1.22 | 1.23 | 1.24 | 1.25 | 1.26 | 1.27 | 1.28 | 1.29 | 1.30 | 1.31 | 1.32 | 1.33 | 1.34 | 1.35 | 1.36 | 1.37 | 1.38 | 1.39 | 1.40 | 1.41 | 1.41 | 1.42 |
| 1390 | 1.14 | 1.15 | 1.16 | 1.17 | 1.18 | 1.19 | 1.20 | 1.21 | 1.22 | 1.23 | 1.24 | 1.25 | 1.26 | 1.27 | 1.28 | 1.29 | 1.30 | 1.31 | 1.32 | 1.33 | 1.34 | 1.34 | 1.35 | 1.36 | 1.37 | 1.38 |
| 1400 | 1.10 | 1.11 | 1.12 | 1.13 | 1.14 | 1.15 | 1.16 | 1.17 | 1.18 | 1.19 | 1.20 | 1.21 | 1.22 | 1.23 | 1.24 | 1.25 | 1.26 | 1.27 | 1.27 | 1.28 | 1.29 | 1.30 | 1.31 | 1.32 | 1.32 | 1.33 |
| 1410 | 1.06 | 1.07 | 1.08 | 1.09 | 1.10 | 1.11 | 1.12 | 1.13 | 1.14 | 1.15 | 1.16 | 1.17 | 1.18 | 1.19 | 1.20 | 1.21 | 1.22 | 1.23 | 1.24 | 1.25 | 1.25 | 1.26 | 1.27 | 1.28 | 1.28 | 1.29 |
| 1420 | 1.03 | 1.04 | 1.05 | 1.06 | 1.07 | 1.08 | 1.09 | 1.10 | 1.11 | 1.12 | 1.13 | 1.14 | 1.15 | 1.16 | 1.17 | 1.18 | 1.19 | 1.20 | 1.21 | 1.22 | 1.22 | 1.22 | 1.23 | 1.24 | 1.24 | 1.25 |
| 1430 | 0.99 | 1.00 | 1.01 | 1.02 | 1.03 | 1.04 | 1.05 | 1.06 | 1.07 | 1.08 | 1.09 | 1.10 | 1.11 | 1.12 | 1.13 | 1.14 | 1.15 | 1.16 | 1.16 | 1.17 | 1.18 | 1.18 | 1.19 | 1.20 | 1.21 | 1.22 |
| 1440 | .964 | .974 | .984 | .994 | 1.00 | 1.01 | 1.02 | 1.03 | 1.04 | 1.05 | 1.06 | 1.07 | 1.08 | 1.09 | 1.10 | 1.10 | 1.11 | 1.12 | 1.13 | 1.14 | 1.14 | 1.15 | 1.16 | 1.16 | 1.17 | 1.18 |
| 1450 | .935 | .945 | .955 | .964 | .974 | .983 | .992 | 1.00 | 1.01 | 1.02 | 1.03 | 1.04 | 1.05 | 1.06 | 1.07 | 1.07 | 1.08 | 1.09 | 1.09 | 1.10 | 1.11 | 1.12 | 1.13 | 1.13 | 1.14 | 1.15 |
| 1460 | .906 | .916 | .925 | .934 | .944 | .953 | .962 | .971 | .980 | .990 | 1.00 | 1.01 | 1.01 | 1.02 | 1.03 | 1.04 | 1.05 | 1.06 | 1.06 | 1.07 | 1.08 | 1.09 | 1.10 | 1.10 | 1.11 | 1.12 |
| 1470 | .875 | .885 | .895 | .905 | .915 | .924 | .934 | .943 | .951 | .960 | .969 | .977 | .985 | .993 | 1.00 | 1.01 | 1.02 | 1.03 | 1.03 | 1.04 | 1.05 | 1.05 | 1.06 | 1.07 | 1.08 | 1.08 |
| 1480 | .851 | .860 | .859 | .878 | .887 | .896 | .905 | .915 | .924 | .933 | .941 | .950 | .958 | .966 | .974 | .982 | .990 | .998 | 1.01 | 1.01 | 1.02 | 1.03 | 1.03 | 1.04 | 1.05 | 1.05 |
| 1490 | .824 | .834 | .844 | .853 | .862 | .871 | .880 | .889 | .898 | .906 | .914 | .922 | .930 | .939 | .947 | .956 | .963 | .970 | .977 | .984 | .991 | .998 | 1.01 | 1.01 | 1.02 | 1.02 |
| 1500 | .799 | .809 | .819 | .828 | .837 | .846 | .855 | .864 | .872 | .881 | .890 | .898 | .905 | .913 | .921 | .929 | .937 | .944 | .952 | .959 | .966 | .973 | .980 | 9.87 | .994 | 1.00 |

Note—This table is calculated taking the specific gravity of the solution as 1.




CURVE VB. DILUTION-RATIO OF SOLUTION TO DRY SLIME

specific gravity of the solution is 1. In the adjoining column opposite 133.3 is found 0.87, the number of cubic feet to be added to 133.3 for each increase of 0.001 in the specific gravity of the solution; $0.87 \times 5 = 4.35$ (total correction) $133.3 + 4.35 = 137.65$ cu.ft. of the pulp specified necessary to make one ton of dry slime. In Table 6 at the intersection of the vertical column 53.03, the number of tons of dry slime in the charge. In order to show the effect of not taking the specific gravity of the solution into account, we have calculated the number of tons of dry slime in the above charge, taking the specific gravity of the solution as 1, and find it to be 54.76, a difference of 1.73 tons.

Curves 1b, 3b, 4b and 5b illustrate how the operator

TABLE VI. NUMBER OF CUBIC FEET FOR EACH FOOT OF DEPTH OF CYLINDRICAL TANKS

Diameter, Feet.

| Diameter, Inches | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 78.54 | 95.03 | 113.1 | 132.7 | 153.9 | 176.7 | 201.1 | 227.0 | 254.5 | 283.5 | 314.2 | 346.4 | 380.1 | 415.5 | 452.4 | 490.9 | 530.9 | 572.6 | 615.8 | 660.5 | 706.9 | 754.8 |
| ½ | 79.19 | 95.75 | 113.9 | 133.5 | 154.8 | 177.7 | 202.1 | 228.1 | 255.6 | 284.7 | 315.5 | 347.7 | 381.5 | 417.0 | 453.9 | 492.5 | 532.6 | 574.3 | 617.6 | 662.4 | 708.8 | 756.8 |
| 1 | 79.85 | 96.48 | 114.7 | 134.4 | 155.8 | 178.7 | 203.2 | 229.2 | 256.8 | 286.0 | 316.8 | 349.1 | 383.0 | 418.5 | 455.5 | 494.2 | 534.3 | 576.1 | 619.4 | 664.3 | 710.8 | 758.8 |
| 1½ | 80.51 | 97.20 | 115.5 | 135.3 | 156.7 | 179.7 | 204.2 | 230.3 | 258.0 | 287.2 | 318.1 | 350.5 | 384.4 | 420.0 | 457.1 | 495.8 | 536.0 | 577.8 | 621.2 | 666.2 | 712.7 | 760.8 |
| 2 | 81.18 | 97.93 | 116.3 | 136.2 | 157.6 | 180.7 | 205.3 | 231.5 | 259.2 | 288.5 | 319.4 | 351.9 | 385.9 | 421.5 | 458.7 | 497.4 | 537.8 | 579.6 | 623.1 | 668.1 | 714.7 | 762.9 |
| 2½ | 81.85 | 98.66 | 117.1 | 137.0 | 158.5 | 181.7 | 206.3 | 232.6 | 260.4 | 289.7 | 320.7 | 353.3 | 387.3 | 423.0 | 460.3 | 499.0 | 539.5 | 581.4 | 624.9 | 670.0 | 716.7 | 764.9 |
| 3 | 82.52 | 99.40 | 117.9 | 137.9 | 159.5 | 182.7 | 207.4 | 233.7 | 261.6 | 291.0 | 322.1 | 354.7 | 388.8 | 424.6 | 461.9 | 500.7 | 541.2 | 583.2 | 626.8 | 672.0 | 718.7 | 767.0 |
| 3½ | 83.19 | 100.1 | 118.7 | 138.7 | 160.4 | 183.7 | 208.4 | 234.8 | 262.8 | 292.3 | 323.4 | 356.0 | 390.2 | 426.1 | 463.4 | 502.4 | 542.9 | 585.0 | 628.6 | 673.9 | 720.7 | 769.0 |
| 4 | 83.86 | 100.9 | 119.5 | 139.6 | 161.4 | 184.7 | 209.5 | 236.0 | 264.0 | 293.6 | 324.7 | 357.4 | 391.7 | 427.6 | 465.0 | 504.1 | 544.6 | 586.8 | 630.5 | 675.8 | 722.7 | 771.1 |
| 4½ | 84.54 | 101.6 | 120.3 | 140.5 | 162.3 | 185.7 | 210.6 | 237.1 | 265.2 | 294.8 | 326.0 | 358.8 | 393.2 | 429.1 | 466.6 | 505.7 | 546.3 | 588.6 | 632.3 | 677.7 | 724.6 | 773.1 |
| 5 | 85.22 | 102.4 | 121.1 | 141.4 | 163.2 | 186.7 | 211.7 | 238.2 | 266.4 | 296.1 | 327.4 | 360.2 | 394.7 | 430.7 | 468.2 | 507.4 | 548.1 | 590.4 | 634.2 | 679.6 | 726.6 | 775.2 |
| 5½ | 85.90 | 103.1 | 121.9 | 142.2 | 164.1 | 187.7 | 212.7 | 239.3 | 267.6 | 297.3 | 328.7 | 361.6 | 396.1 | 432.2 | 469.8 | 509.0 | 549.8 | 592.2 | 636.0 | 681.5 | 728.6 | 777.2 |
| 6 | 86.59 | 103.9 | 122.7 | 143.1 | 165.1 | 188.7 | 213.8 | 240.5 | 268.8 | 298.6 | 330.1 | 363.1 | 397.6 | 433.7 | 471.4 | 510.7 | 551.5 | 594.0 | 637.9 | 683.5 | 730.6 | 779.3 |
| 6½ | 87.28 | 104.6 | 123.5 | 144.0 | 166.0 | 189.7 | 214.9 | 241.6 | 270.0 | 299.9 | 331.4 | 364.5 | 399.1 | 435.2 | 473.0 | 512.3 | 553.2 | 595.8 | 639.8 | 685.4 | 732.6 | 781.3 |
| 7 | 87.97 | 105.4 | 124.4 | 144.9 | 167.0 | 190.7 | 216.0 | 242.8 | 271.2 | 301.2 | 332.8 | 365.9 | 400.6 | 436.8 | 474.6 | 514.0 | 555.0 | 597.6 | 641.7 | 687.4 | 734.6 | 783.4 |
| 7½ | 88.66 | 106.1 | 125.2 | 145.8 | 167.9 | 191.7 | 217.1 | 243.9 | 272.4 | 302.5 | 334.1 | 367.3 | 402.0 | 438.3 | 476.2 | 515.7 | 556.7 | 599.4 | 643.5 | 689.3 | 736.6 | 785.5 |
| 8 | 89.36 | 106.9 | 126.0 | 146.7 | 168.9 | 192.8 | 218.2 | 245.1 | 273.7 | 303.8 | 335.5 | 368.7 | 403.5 | 439.9 | 477.9 | 517.4 | 558.5 | 601.2 | 645.4 | 691.2 | 738.6 | 787.6 |
| 8½ | 90.06 | 107.6 | 126.8 | 147.6 | 169.9 | 193.8 | 219.3 | 246.2 | 274.9 | 305.1 | 336.8 | 370.1 | 405.0 | 441.4 | 479.5 | 519.1 | 560.2 | 603.0 | 647.2 | 693.1 | 740.6 | 789.6 |
| 9 | 90.76 | 108.4 | 127.7 | 148.5 | 170.9 | 194.8 | 220.4 | 247.4 | 276.1 | 306.4 | 338.2 | 371.5 | 406.5 | 443.0 | 481.1 | 520.8 | 562.0 | 604.8 | 649.2 | 695.1 | 742.6 | 791.7 |
| 9½ | 91.47 | 109.2 | 128.5 | 149.4 | 171.8 | 195.8 | 221.5 | 248.6 | 277.3 | 307.6 | 339.5 | 372.9 | 408.0 | 444.5 | 482.7 | 522.4 | 563.7 | 606.6 | 651.0 | 697.0 | 744.6 | 793.8 |
| 10 | 92.18 | 110.0 | 129.4 | 150.3 | 172.8 | 196.9 | 222.6 | 249.8 | 278.6 | 308.9 | 340.9 | 374.4 | 409.5 | 446.1 | 484.4 | 524.1 | 565.6 | 608.4 | 652.9 | 699.0 | 746.7 | 795.9 |
| 10½ | 92.89 | 110.7 | 130.2 | 151.2 | 173.8 | 197.9 | 223.7 | 250.9 | 279.8 | 310.2 | 342.2 | 375.8 | 411.0 | 447.7 | 486.0 | 525.8 | 567.2 | 610.2 | 654.8 | 700.9 | 748.7 | 798.0 |
| 11 | 93.60 | 111.5 | 131.0 | 152.1 | 174.8 | 199.0 | 224.8 | 252.1 | 281.0 | 311.5 | 343.6 | 377.3 | 412.5 | 449.3 | 487.6 | 527.5 | 569.0 | 612.1 | 656.7 | 702.9 | 750.7 | 800.1 |
| 11½ | 94.31 | 112.3 | 131.8 | 153.0 | 175.7 | 200.0 | 225.9 | 253.3 | 282.2 | 312.8 | 345.0 | 378.7 | 414.0 | 450.8 | 489.2 | 529.2 | 570.8 | 613.9 | 658.6 | 704.9 | 752.7 | 802.1 |

| Diameter, Inches | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 804.2 | 855.3 | 907.9 | 962.1 | 1018 | 1075 | 1134 | 1195 | 1257 | 1320 | 1385 | 1452 | 1521 | 1590 | 1662 | 1735 | 1810 | 1886 | 1963 | 2043 | 2124 | 2206 | 2290 |
| ½ | 806.3 | 857.4 | 910.1 | 964.4 | 1020 | 1077 | 1136 | 1197 | 1259 | 1323 | 1388 | 1455 | 1523 | 1593 | 1665 | 1738 | 1813 | 1889 | 1966 | 2046 | 2127 | 2209 | 2293 |
| 1 | 808.4 | 859.6 | 912.4 | 966.7 | 1023 | 1080 | 1139 | 1200 | 1262 | 1326 | 1391 | 1458 | 1526 | 1596 | 1668 | 1741 | 1816 | 1892 | 1970 | 2050 | 2131 | 2213 | 2297 |
| 1½ | 810.5 | 861.8 | 914.6 | 969.0 | 1025 | 1082 | 1141 | 1202 | 1264 | 1328 | 1393 | 1460 | 1529 | 1599 | 1671 | 1744 | 1819 | 1895 | 1973 | 2053 | 2134 | 2216 | 2300 |
| 2 | 812.6 | 864.0 | 916.8 | 971.3 | 1027 | 1085 | 1144 | 1205 | 1267 | 1331 | 1396 | 1463 | 1532 | 1602 | 1674 | 1747 | 1822 | 1899 | 1977 | 2056 | 2137 | 2220 | 2304 |
| 2½ | 814.7 | 866.1 | 919.0 | 973.6 | 1029 | 1087 | 1146 | 1207 | 1269 | 1333 | 1399 | 1466 | 1535 | 1605 | 1677 | 1750 | 1825 | 1902 | 1980 | 2059 | 2140 | 2223 | 2307 |
| 3 | 816.9 | 868.3 | 921.3 | 975.9 | 1032 | 1090 | 1149 | 1210 | 1272 | 1336 | 1402 | 1469 | 1538 | 1608 | 1680 | 1753 | 1828 | 1905 | 1983 | 2063 | 2144 | 2227 | 2311 |
| 3½ | 819.0 | 870.5 | 923.5 | 978.2 | 1034 | 1092 | 1151 | 1212 | 1275 | 1339 | 1405 | 1472 | 1541 | 1611 | 1683 | 1756 | 1831 | 1908 | 1986 | 2066 | 2147 | 2230 | 2315 |
| 4 | 821.1 | 872.7 | 925.8 | 980.5 | 1037 | 1095 | 1154 | 1215 | 1278 | 1342 | 1408 | 1475 | 1544 | 1614 | 1686 | 1760 | 1835 | 1911 | 1990 | 2070 | 2151 | 2234 | 2319 |
| 4½ | 823.2 | 874.8 | 928.0 | 982.8 | 1039 | 1097 | 1156 | 1217 | 1280 | 1344 | 1410 | 1477 | 1546 | 1617 | 1689 | 1763 | 1838 | 1914 | 1993 | 2073 | 2154 | 2237 | 2322 |
| 5 | 825.3 | 877.0 | 930.3 | 985.2 | 1042 | 1100 | 1159 | 1220 | 1283 | 1347 | 1413 | 1480 | 1549 | 1620 | 1692 | 1766 | 1841 | 1918 | 1996 | 2076 | 2158 | 2241 | 2326 |
| 5½ | 827.4 | 879.2 | 932.5 | 987.5 | 1044 | 1102 | 1161 | 1222 | 1285 | 1350 | 1416 | 1483 | 1552 | 1623 | 1695 | 1769 | 1844 | 1921 | 1999 | 2079 | 2161 | 2244 | 2329 |
| 6 | 829.6 | 881.4 | 934.8 | 989.8 | 1046 | 1104 | 1164 | 1225 | 1288 | 1353 | 1419 | 1486 | 1555 | 1627 | 1698 | 1774 | 1847 | 1924 | 2003 | 2083 | 2165 | 2248 | 2333 |
| 6½ | 831.7 | 883.6 | 937.0 | 992.1 | 1048 | 1106 | 1166 | 1228 | 1291 | 1355 | 1421 | 1489 | 1558 | 1629 | 1701 | 1775 | 1850 | 1927 | 2006 | 2086 | 2168 | 2251 | 2336 |
| 7 | 833.8 | 885.8 | 939.3 | 994.5 | 1051 | 1109 | 1169 | 1231 | 1294 | 1358 | 1424 | 1492 | 1561 | 1632 | 1704 | 1778 | 1854 | 1931 | 2010 | 2090 | 2172 | 2255 | 2340 |
| 7½ | 835.9 | 888.0 | 941.6 | 996.8 | 1053 | 1111 | 1171 | 1233 | 1296 | 1361 | 1427 | 1495 | 1564 | 1635 | 1707 | 1781 | 1857 | 1934 | 2013 | 2093 | 2175 | 2258 | 2343 |
| 8 | 838.1 | 890.2 | 943.9 | 999.1 | 1056 | 1114 | 1174 | 1236 | 1299 | 1364 | 1430 | 1498 | 1567 | 1638 | 1710 | 1785 | 1860 | 1937 | 2016 | 2097 | 2179 | 2262 | 2347 |
| 8½ | 840.2 | 892.4 | 946.1 | 1001 | 1058 | 1116 | 1176 | 1238 | 1301 | 1366 | 1432 | 1500 | 1570 | 1641 | 1713 | 1788 | 1863 | 1940 | 2019 | 2100 | 2182 | 2265 | 2351 |
| 9 | 842.4 | 894.6 | 948.4 | 1004 | 1061 | 1119 | 1179 | 1241 | 1304 | 1369 | 1435 | 1503 | 1573 | 1644 | 1717 | 1791 | 1867 | 1944 | 2023 | 2103 | 2185 | 2269 | 2354 |
| 9½ | 844.5 | 896.8 | 950.1 | 1006 | 1063 | 1121 | 1181 | 1243 | 1307 | 1371 | 1438 | 1506 | 1576 | 1647 | 1720 | 1794 | 1870 | 1947 | 2026 | 2106 | 2188 | 2273 | 2357 |
| 10 | 846.7 | 899.0 | 953.0 | 1008 | 1066 | 1124 | 1184 | 1246 | 1310 | 1374 | 1441 | 1509 | 1579 | 1650 | 1723 | 1797 | 1873 | 1950 | 2029 | 2110 | 2192 | 2276 | 2361 |
| 10½ | 848.8 | 901.2 | 955.2 | 1010 | 1068 | 1126 | 1186 | 1248 | 1312 | 1377 | 1444 | 1512 | 1582 | 1653 | 1726 | 1800 | 1876 | 1953 | 2032 | 2113 | 2195 | 2279 | 2365 |
| 11 | 851.0 | 903.5 | 957.5 | 1013 | 1069 | 1129 | 1189 | 1251 | 1315 | 1380 | 1447 | 1515 | 1585 | 1656 | 1729 | 1803 | 1879 | 1957 | 2036 | 2117 | 2199 | 2283 | 2369 |
| 11½ | 853.1 | 905.7 | 959.8 | 1015 | 1072 | 1131 | 1192 | 1254 | 1317 | 1382 | 1450 | 1518 | 1587 | 1659 | 1732 | 1806 | 1882 | 1960 | 2039 | 2120 | 2202 | 2286 | 2372 |

| Diameter, Inches | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2376 | 2463 | 2552 | 2642 | 2734 | 2827 | 2922 | 3019 | 3117 | 3217 | 3318 | 3421 | 3526 | 3632 | 3739 | 3848 | 3959 | 4072 | 4185 | 4301 | 4418 | 4536 |
| ½ | 2379 | 2466 | 2555 | 2646 | 2738 | 2831 | 2926 | 3023 | 3121 | 3221 | 3322 | 3425 | 3530 | 3636 | 3743 | 3853 | 3963 | 4076 | 4190 | 4306 | 4423 | 4541 |
| 1 | 2383 | 2470 | 2559 | 2650 | 2742 | 2835 | 2930 | 3027 | 3125 | 3225 | 3327 | 3430 | 3534 | 3641 | 3748 | 3858 | 3968 | 4081 | 4195 | 4311 | 4428 | 4546 |
| 1½ | 2386 | 2474 | 2563 | 2653 | 2745 | 2839 | 2934 | 3031 | 3129 | 3229 | 3331 | 3434 | 3538 | 3645 | 3752 | 3862 | 3973 | 4085 | 4200 | 4315 | 4433 | 4551 |
| 2 | 2390 | 2478 | 2567 | 2657 | 2749 | 2843 | 2938 | 3035 | 3134 | 3234 | 3335 | 3438 | 3543 | 3650 | 3757 | 3867 | 3978 | 4090 | 4205 | 4320 | 4438 | 4556 |
| 2½ | 2393 | 2481 | 2570 | 2661 | 2753 | 2847 | 2942 | 3039 | 3138 | 3238 | 3339 | 3442 | 3547 | 3654 | 3761 | 3871 | 3982 | 4095 | 4209 | 4325 | 4442 | 4561 |
| 3 | 2397 | 2485 | 2574 | 2665 | 2757 | 2851 | 2946 | 3043 | 3142 | 3242 | 3344 | 3447 | 3552 | 3658 | 3766 | 3876 | 3987 | 4100 | 4214 | 4330 | 4447 | 4566 |
| 3½ | 2401 | 2488 | 2578 | 2669 | 2761 | 2855 | 2950 | 3047 | 3146 | 3246 | 3348 | 3451 | 3556 | 3662 | 3770 | 3880 | 3991 | 4104 | 4219 | 4335 | 4452 | 4571 |
| 4 | 2405 | 2492 | 2582 | 2673 | 2765 | 2859 | 2954 | 3052 | 3150 | 3251 | 3352 | 3456 | 3561 | 3667 | 3775 | 3885 | 3996 | 4109 | 4224 | 4340 | 4457 | 4576 |
| 4½ | 2408 | 2496 | 2585 | 2676 | 2769 | 2863 | 2958 | 3056 | 3154 | 3255 | 3356 | 3460 | 3565 | 3671 | 3780 | 3889 | 4001 | 4114 | 4228 | 4344 | 4462 | 4581 |
| 5 | 2412 | 2500 | 2589 | 2680 | 2773 | 2867 | 2963 | 3060 | 3159 | 3259 | 3361 | 3465 | 3570 | 3676 | 3785 | 3894 | 4006 | 4119 | 4233 | 4349 | 4467 | 4586 |
| 5½ | 2415 | 2503 | 2593 | 2684 | 2777 | 2871 | 2967 | 3064 | 3163 | 3263 | 3365 | 3469 | 3574 | 3680 | 3789 | 3899 | 4010 | 4123 | 4238 | 4354 | 4472 | 4591 |
| 6 | 2419 | 2507 | 2597 | 2688 | 2781 | 2875 | 2971 | 3068 | 3167 | 3267 | 3370 | 3473 | 3578 | 3685 | 3794 | 3904 | 4015 | 4128 | 4243 | 4359 | 4477 | 4596 |
| 6½ | 2422 | 2511 | 2600 | 2691 | 2784 | 2879 | 2975 | 3072 | 3171 | 3271 | 3374 | 3477 | 3582 | 3689 | 3798 | 3908 | 4020 | 4133 | 4248 | 4364 | 4482 | 4601 |
| 7 | 2426 | 2515 | 2604 | 2695 | 2788 | 2883 | 2979 | 3076 | 3175 | 3276 | 3378 | 3482 | 3587 | 3694 | 3803 | 3913 | 4025 | 4138 | 4253 | 4369 | 4487 | 4606 |
| 7½ | 2430 | 2518 | 2608 | 2699 | 2792 | 2887 | 2983 | 3080 | 3179 | 3280 | 3382 | 3486 | 3591 | 3698 | 3807 | 3917 | 4029 | 4142 | 4257 | 4374 | 4492 | 4611 |
| 8 | 2434 | 2522 | 2612 | 2703 | 2796 | 2891 | 2987 | 3084 | 3184 | 3284 | 3387 | 3491 | 3596 | 3703 | 3812 | 3922 | 4034 | 4147 | 4262 | 4379 | 4497 | 4616 |
| 8½ | 2437 | 2525 | 2615 | 2707 | 2800 | 2895 | 2991 | 3088 | 3188 | 3288 | 3391 | 3495 | 3600 | 3707 | 3816 | 3926 | 4038 | 4152 | 4267 | 4383 | 4502 | 4621 |
| 9 | 2441 | 2529 | 2619 | 2711 | 2804 | 2899 | 2995 | 3093 | 3192 | 3293 | 3395 | 3499 | 3605 | 3712 | 3821 | 3931 | 4043 | 4157 | 4272 | 4388 | 4507 | 4626 |
| 9½ | 2444 | 2533 | 2623 | 2715 | 2808 | 2903 | 2999 | 3097 | 3196 | 3297 | 3399 | 3503 | 3609 | 3716 | 3825 | 3936 | 4048 | 4161 | 4276 | 4393 | 4512 | 4631 |
| 10 | 2448 | 2537 | 2627 | 2719 | 2812 | 2907 | 3003 | 3101 | 3200 | 3301 | 3404 | 3508 | 3614 | 3721 | 3830 | 3941 | 4053 | 4166 | 4281 | 4398 | 4517 | 4636 |
| 10½ | 2452 | 2540 | 2630 | 2722 | 2816 | 2910 | 3007 | 3105 | 3204 | 3305 | 3408 | 3512 | 3618 | 3725 | 3834 | 3945 | 4057 | 4171 | 4286 | 4403 | 4522 | 4641 |
| 11 | 2456 | 2544 | 2634 | 2726 | 2820 | 2914 | 3011 | 3109 | 3209 | 3310 | 3413 | 3517 | 3623 | 3730 | 3839 | 3950 | 4062 | 4176 | 4291 | 4408 | 4527 | 4647 |
| 11½ | 2459 | 2548 | 2638 | 2730 | 2823 | 2918 | 3015 | 3113 | 3213 | 3314 | 3417 | 3521 | 3627 | 3734 | 3843 | 3954 | 4067 | 4180 | 4296 | 4413 | 4531 | 4652 |

| Diameter, Inches | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4657 | 4778 | 4902 | 5027 | 5153 | 5281 | 5411 | 5542 | 5675 | 5809 | 5945 | 6082 | 6221 | 6362 | 6504 | 6648 | 6793 | 6940 | 7088 | 7238 | 7390 | 7543 | 7698 |
| ½ | 4662 | 4783 | 4907 | 5032 | 5158 | 5286 | 5416 | 5547 | 5680 | 5814 | 5950 | 6088 | 6227 | 6368 | 6510 | 6654 | 6799 | 6946 | 7094 | 7244 | 7396 | 7549 | 7704 |
| 1 | 4667 | 4789 | 4913 | 5037 | 5164 | 5292 | 5421 | 5553 | 5686 | 5820 | 5956 | 6094 | 6233 | 6374 | 6516 | 6660 | 6805 | 6952 | 7101 | 7251 | 7403 | 7556 | 7711 |
| 1½ | 4672 | 4794 | 4917 | 5042 | 5169 | 5297 | 5426 | 5558 | 5691 | 5825 | 5961 | 6099 | 6238 | 6379 | 6522 | 6666 | 6811 | 6958 | 7107 | 7257 | 7409 | 7562 | 7717 |
| 2 | 4677 | 4799 | 4922 | 5048 | 5174 | 5303 | 5432 | 5564 | 5697 | 5831 | 5967 | 6105 | 6244 | 6385 | 6528 | 6672 | 6817 | 6964 | 7113 | 7263 | 7415 | 7569 | 7724 |
| 2½ | 4682 | 4804 | 4927 | 5053 | 5179 | 5308 | 5437 | 5569 | 5702 | 5837 | 5973 | 6111 | 6250 | 6391 | 6534 | 6678 | 6823 | 6970 | 7119 | 7269 | 7421 | 7575 | 7730 |
| 3 | 4687 | 4809 | 4933 | 5058 | 5185 | 5313 | 5443 | 5575 | 5708 | 5843 | 5979 | 6117 | 6256 | 6397 | 6540 | 6684 | 6829 | 6977 | 7126 | 7276 | 7428 | 7581 | 7737 |
| 3½ | 4692 | 4814 | 4938 | 5063 | 5190 | 5318 | 5448 | 5580 | 5713 | 5848 | 4984 | 6122 | 6262 | 6403 | 6546 | 6690 | 6835 | 6983 | 7132 | 7282 | 7434 | 7587 | 7743 |
| 4 | 4697 | 4819 | 4943 | 5069 | 5195 | 5324 | 5454 | 5586 | 5719 | 5854 | 5990 | 6128 | 6268 | 6409 | 6552 | 6696 | 6842 | 6989 | 7138 | 7289 | 7441 | 7594 | 7750 |
| 4½ | 4702 | 4824 | 4948 | 5074 | 5200 | 5329 | 5459 | 5591 | 5724 | 5859 | 5996 | 6134 | 6274 | 6415 | 6558 | 6702 | 6848 | 6995 | 7144 | 7295 | 7447 | 7600 | 7756 |
| 5 | 4707 | 4830 | 4954 | 5079 | 5206 | 5335 | 5465 | 5597 | 5730 | 5865 | 6002 | 6140 | 6280 | 6421 | 6564 | 6708 | 6854 | 7001 | 7151 | 7301 | 7453 | 7607 | 7763 |
| 5½ | 4712 | 4835 | 4959 | 5084 | 5211 | 5340 | 5470 | 5602 | 5735 | 5871 | 9007 | 6145 | 6285 | 6427 | 6570 | 6714 | 6860 | 7007 | 7157 | 7307 | 7459 | 7613 | 7769 |
| 6 | 4717 | 4840 | 4964 | 5090 | 5217 | 5346 | 5476 | 5608 | 5741 | 5877 | 6013 | 6151 | 6291 | 6433 | 6576 | 6720 | 6866 | 7014 | 7163 | 7314 | 7466 | 7620 | 7776 |
| 6½ | 4722 | 4845 | 4969 | 5095 | 5222 | 5351 | 5481 | 5613 | 5747 | 5882 | 6019 | 6157 | 6297 | 6438 | 6582 | 6726 | 6872 | 7020 | 7169 | 7320 | 7472 | 7626 | 7782 |
| 7 | 4727 | 4850 | 4974 | 5100 | 5227 | 5356 | 5487 | 5619 | 5753 | 5888 | 6025 | 6163 | 6303 | 6444 | 6588 | 6732 | 6878 | 7026 | 7176 | 7326 | 7479 | 7633 | 7789 |
| 7½ | 4732 | 4855 | 4979 | 5105 | 5232 | 5361 | 5492 | 5624 | 5758 | 5893 | 6030 | 6169 | 6309 | 6450 | 6594 | 6738 | 6884 | 7032 | 7182 | 7332 | 7485 | 7639 | 7795 |
| 8 | 4738 | 4860 | 4985 | 5111 | 5238 | 5367 | 5498 | 5630 | 5764 | 5899 | 6036 | 6175 | 6315 | 6456 | 6600 | 6744 | 6891 | 7039 | 7188 | 7339 | 7492 | 7646 | 7802 |
| 8½ | 4743 | 4865 | 4990 | 5116 | 5243 | 5372 | 5503 | 5635 | 5769 | 5905 | 6042 | 6180 | 6320 | 6462 | 6606 | 6750 | 6897 | 7045 | 7194 | 7345 | 7498 | 7652 | 7808 |
| 9 | 4748 | 4871 | 4995 | 5121 | 5249 | 5378 | 5509 | 5641 | 5775 | 5911 | 6048 | 6186 | 6326 | 6468 | 6612 | 6756 | 6903 | 7051 | 7201 | 7352 | 7505 | 7659 | 7815 |
| 9½ | 4753 | 4876 | 5000 | 5126 | 5254 | 5383 | 5514 | 5646 | 5780 | 5916 | 6053 | 6192 | 6332 | 6474 | 6618 | 6762 | 6909 | 7057 | 7207 | 7358 | 7511 | 7665 | 7821 |
| 10 | 4758 | 4881 | 5006 | 5132 | 5260 | 5389 | 5520 | 5652 | 5786 | 5922 | 6059 | 6198 | 6338 | 6480 | 6624 | 6769 | 6915 | 7063 | 7213 | 7364 | 7517 | 7672 | 7828 |
| 10½ | 4763 | 4886 | 5011 | 5137 | 5265 | 5394 | 5525 | 5657 | 5792 | 5927 | 6065 | 6203 | 6344 | 6486 | 6630 | 6775 | 6921 | 7069 | 7219 | 7370 | 7523 | 7678 | 7834 |
| 11 | 4768 | 4891 | 5016 | 5142 | 5270 | 5400 | 5531 | 5663 | 5798 | 5933 | 6071 | 6209 | 6350 | 6492 | 6636 | 6781 | 6927 | 7076 | 7226 | 7377 | 7530 | 7685 | 7841 |
| 11½ | 4773 | 4896 | 5021 | 5147 | 5275 | 5405 | 5536 | 5669 | 5803 | 5939 | 6076 | 6215 | 6356 | 6498 | 6642 | 6787 | 6933 | 7082 | 7232 | 7383 | 7536 | 7691 | 7847 |
| | | | | | | | | | | | | | | | | | | | | | | | 7854 |

may use the data contained in any of the tables for plotting large-scale curves covering the particular work which he may have in hand.

Curve 1b shows graphically a few of the values given in Table 1. When the specific gravities of the dry slime and solution are constant, or nearly so, a single curve may be plotted, but when there is considerable variation in these factors, the uncorrected percentages for all specific gravities of dry slime and any particular weight of one liter of pulp may be indicated by heavy lines. Directly beneath each heavy line should be light lines giving the corrected percentages for pulps covering the range of the specific gravities of the solutions used. In using this curve, follow the vertical line representing the specific gravity of the dry slime to the point where it intersects the heavy line representing the weight of one liter of the pulp, drop below to the light line or intermediate point representing the specific gravity of the solution, then follow horizontally, either to the right or left, and read corrected percentage.

TABLE VIb. LOGARITHMS OF THE NUMBER OF CUBIC FEET FOR EACH FOOT OF DEPTH OF CYLINDRICAL TANKS

| Diameter, Inches | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .8951 | .9779 | .0535 | .1229 | .1872 | .2472 | .3034 | .3560 | .4057 | .4526 | .4972 | .5396 | .5799 | .6186 | .6555 | .6910 | .7250 | .7579 | .7894 | .8199 | .8494 | .8778 |
| ¼ | .8987 | .9811 | .0565 | .1255 | .1898 | .2497 | .3056 | .3581 | .4076 | .4544 | .4990 | .5412 | .5815 | .6201 | .6570 | .6924 | .7264 | .7591 | .7907 | .8211 | .8505 | .8790 |
| ½ | .9023 | .9844 | .0596 | .1284 | .1926 | .2521 | .3079 | .3602 | .4096 | .4564 | .5008 | .5429 | .5832 | .6217 | .6585 | .6939 | .7278 | .7605 | .7920 | .8224 | .8517 | .8801 |
| ¾ | .9058 | .9877 | .0626 | .1313 | .1951 | .2545 | .3101 | .3623 | .4116 | .4582 | .5026 | .5447 | .5848 | .6232 | .6600 | .6953 | .7292 | .7618 | .7932 | .8236 | .8529 | .8813 |
| 1 | .9094 | .9909 | .0656 | .1342 | .1976 | .2570 | .3124 | .3646 | .4136 | .4601 | .5043 | .5464 | .5865 | .6248 | .6615 | .6967 | .7306 | .7631 | .7946 | .8248 | .8541 | .8825 |
| 1¼ | .9130 | .9941 | .0686 | .1367 | .2000 | .2594 | .3145 | .3666 | .4156 | .4619 | .5061 | .5481 | .5880 | .6263 | .6630 | .6981 | .7320 | .7645 | .7958 | .8261 | .8553 | .8836 |
| 1½ | .9166 | .9974 | .0715 | .1396 | .2028 | .2617 | .3168 | .3687 | .4176 | .4639 | .5080 | .5499 | .5897 | .6280 | .6645 | .6996 | .7334 | .7658 | .7971 | .8274 | .8565 | .8848 |
| 1¾ | .9201 | .0004 | .0745 | .1421 | .2052 | .2641 | .3189 | .3707 | .4196 | .4658 | .5097 | .5514 | .5913 | .6295 | .6660 | .7010 | .7347 | .7672 | .7984 | .8286 | .8578 | .8859 |
| 2 | .9236 | .0039 | .0774 | .1449 | .2079 | .2665 | .3212 | .3729 | .4216 | .4678 | .5115 | .5532 | .5930 | .6310 | .6675 | .7025 | .7361 | .7685 | .7997 | .8298 | .8590 | .8871 |
| 2¼ | .9271 | .0069 | .0803 | .1477 | .2103 | .2688 | .3235 | .3749 | .4236 | .4695 | .5132 | .5549 | .5946 | .6326 | .6689 | .7039 | .7374 | .7698 | .8009 | .8310 | .8601 | .8882 |
| 2½ | .9305 | .0103 | .0831 | .1504 | .2127 | .2711 | .3257 | .3769 | .4255 | .4714 | .5151 | .5565 | .5963 | .6342 | .6704 | .7054 | .7389 | .7711 | .8022 | .8323 | .8613 | .8894 |
| 2¾ | .9340 | .0133 | .0860 | .1529 | .2151 | .2735 | .3278 | .3789 | .4275 | .4732 | .5168 | .5582 | .5978 | .6357 | .6719 | .7067 | .7402 | .7725 | .8035 | .8335 | .8625 | .8905 |
| 3 | .9375 | .0166 | .0888 | .1556 | .2177 | .2758 | .3300 | .3811 | .4294 | .4751 | .5186 | .5600 | .5994 | .6372 | .6734 | .7082 | .7415 | .7738 | .8048 | .8347 | .8637 | .8917 |
| 3¼ | .9409 | .0195 | .0917 | .1584 | .2201 | .2781 | .3322 | .3831 | .4314 | .4770 | .5204 | .5617 | .6011 | .6387 | .6749 | .7095 | .7429 | .7751 | .8060 | .8359 | .8649 | .8928 |
| 3½ | .9443 | .0228 | .0948 | .1611 | .2227 | .2804 | .3345 | .3852 | .4333 | .4789 | .5222 | .5634 | .6027 | .6403 | .6763 | .7110 | .7443 | .7764 | .8073 | .8372 | .8661 | .8940 |
| 3¾ | .9477 | .0257 | .0976 | .1638 | .2251 | .2826 | .3367 | .3872 | .4352 | .4807 | .5239 | .5650 | .6042 | .6418 | .6778 | .7124 | .7456 | .7777 | .8085 | .8384 | .8672 | .8951 |
| 4 | .9511 | .0290 | .1004 | .1664 | .2276 | .2851 | .3389 | .3893 | .4373 | .4826 | .5257 | .5667 | .6058 | .6434 | .6793 | .7138 | .7470 | .7790 | .8098 | .8396 | .8684 | .8963 |
| 4¼ | .9545 | .0318 | .1031 | .1691 | .2302 | .2874 | .3410 | .3913 | .4392 | .4844 | .5274 | .5683 | .6075 | .6448 | .6808 | .7153 | .7483 | .7803 | .8111 | .8408 | .8696 | .8974 |
| 4½ | .9579 | .0350 | .1062 | .1717 | .2327 | .2896 | .3432 | .3934 | .4411 | .4863 | .5292 | .5700 | .6091 | .6464 | .6822 | .7167 | .7497 | .7816 | .8124 | .8420 | .8708 | .8986 |
| 4¾ | .9613 | .0382 | .1089 | .1744 | .2350 | .2918 | .3454 | .3955 | .4429 | .4880 | .5308 | .5716 | .6107 | .6479 | .6837 | .7180 | .7510 | .7829 | .8136 | .8432 | .8719 | .8997 |
| 5 | .9646 | .0414 | .1119 | .1770 | .2375 | .2942 | .3475 | .3976 | .4450 | .4898 | .5326 | .5733 | .6123 | .6494 | .6852 | .7194 | .7524 | .7842 | .8148 | .8445 | .8731 | .9009 |
| 5¼ | .9680 | .0441 | .1146 | .1796 | .2400 | .2964 | .3497 | .3995 | .4468 | .4916 | .5343 | .5750 | .6138 | .6510 | .6866 | .7208 | .7537 | .7855 | .8161 | .8457 | .8743 | .9020 |
| 5½ | .9713 | .0473 | .1173 | .1821 | .2425 | .2989 | .3518 | .4016 | .4487 | .4935 | .5361 | .5767 | .6154 | .6525 | .6881 | .7222 | .7551 | .7868 | .8174 | .8469 | .8755 | .9031 |
| 5¾ | .9746 | .0504 | .1199 | .1847 | .2448 | .3010 | .3539 | .4036 | .4506 | .4953 | .5378 | .5783 | .6170 | .6540 | .6895 | .7236 | .7565 | .7881 | .8186 | .8481 | .8766 | .9042 |

| Diameter, Inches | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .9054 | .9321 | .9580 | .9832 | .0077 | .0314 | .0546 | .0774 | .0993 | .1206 | .1414 | .1620 | .1821 | .2014 | .2206 | .2393 | .2577 | .2755 | .2929 | .3103 | .3272 | .3436 | .3598 |
| ¼ | .9065 | .9332 | .9591 | .9843 | .0086 | .0322 | .0554 | .0781 | .1000 | .1216 | .1424 | .1629 | .1827 | .2022 | .2214 | .2400 | .2584 | .2762 | .2936 | .3109 | .3278 | .3442 | .3604 |
| ½ | .9076 | .9343 | .9602 | .9853 | .0099 | .0334 | .0565 | .0792 | .1011 | .1225 | .1433 | .1638 | .1836 | .2030 | .2222 | .2408 | .2591 | .2769 | .2945 | .3118 | .3286 | .3450 | .3612 |
| ¾ | .9088 | .9354 | .9612 | .9863 | .0107 | .0342 | .0573 | .0799 | .1017 | .1232 | .1440 | .1644 | .1844 | .2038 | .2230 | .2415 | .2598 | .2776 | .2951 | .3124 | .3292 | .3456 | .3617 |
| 1 | .9099 | .9365 | .9623 | .9874 | .0116 | .0354 | .0584 | .0810 | .1028 | .1242 | .1449 | .1652 | .1853 | .2047 | .2238 | .2423 | .2605 | .2785 | .2960 | .3130 | .3298 | .3464 | .3625 |
| 1¼ | .9110 | .9376 | .9633 | .9884 | .0124 | .0362 | .0592 | .0817 | .1035 | .1248 | .1458 | .1661 | .1861 | .2055 | .2245 | .2430 | .2613 | .2792 | .2967 | .3137 | .3304 | .3469 | .3630 |
| 1½ | .9122 | .9387 | .9644 | .9894 | .0137 | .0374 | .0603 | .0828 | .1045 | .1258 | .1467 | .1670 | .1870 | .2063 | .2253 | .2438 | .2620 | .2799 | .2973 | .3145 | .3312 | .3477 | .3638 |
| 1¾ | .9133 | .9398 | .9654 | .9904 | .0145 | .0382 | .0611 | .0835 | .1055 | .1268 | .1477 | .1679 | .1878 | .2071 | .2261 | .2445 | .2627 | .2806 | .2980 | .3151 | .3318 | .3483 | .3646 |
| 2 | .9144 | .9409 | .9665 | .9914 | .0158 | .0394 | .0622 | .0846 | .1065 | .1278 | .1486 | .1688 | .1886 | .2079 | .2269 | .2455 | .2636 | .2813 | .2989 | .3160 | .3326 | .3491 | .3653 |
| 2¼ | .9155 | .9419 | .9675 | .9925 | .0166 | .0402 | .0630 | .0853 | .1072 | .1284 | .1492 | .1694 | .1892 | .2087 | .2276 | .2463 | .2643 | .2819 | .2995 | .3166 | .3332 | .3497 | .3659 |
| 2½ | .9166 | .9430 | .9686 | .9935 | .0179 | .0414 | .0641 | .0864 | .1082 | .1294 | .1501 | .1703 | .1901 | .2095 | .2284 | .2470 | .2651 | .2828 | .3002 | .3172 | .3341 | .3504 | .3666 |
| 2¾ | .9177 | .9441 | .9696 | .9945 | .0187 | .0422 | .0648 | .0871 | .1089 | .1303 | .1511 | .1711 | .1909 | .2103 | .2292 | .2477 | .2658 | .2835 | .3008 | .3179 | .3347 | .3510 | .3672 |
| 3 | .9189 | .9452 | .9707 | .9955 | .0195 | .0430 | .0660 | .0881 | .1099 | .1313 | .1520 | .1720 | .1917 | .2111 | .2299 | .2485 | .2665 | .2842 | .3017 | .3187 | .3355 | .3518 | .3679 |
| 3¼ | .9200 | .9463 | .9717 | .9966 | .0204 | .0438 | .0667 | .0892 | .1109 | .1319 | .1526 | .1729 | .1926 | .2119 | .2307 | .2492 | .2672 | .2849 | .3023 | .3193 | .3361 | .3524 | .3685 |
| 3½ | .9211 | .9473 | .9728 | .9976 | .0216 | .0449 | .0678 | .0903 | .1119 | .1329 | .1535 | .1738 | .1934 | .2127 | .2315 | .2499 | .2681 | .2858 | .3032 | .3201 | .3369 | .3531 | .3692 |
| 3¾ | .9222 | .9484 | .9739 | .9986 | .0224 | .0457 | .0686 | .0910 | .1126 | .1339 | .1544 | .1746 | .1942 | .2135 | .2322 | .2507 | .2688 | .2865 | .3038 | .3208 | .3375 | .3537 | .3698 |
| 4 | .9233 | .9495 | .9749 | .9996 | .0237 | .0469 | .0697 | .0920 | .1136 | .1348 | .1553 | .1755 | .1951 | .2143 | .2330 | .2516 | .2695 | .2871 | .3045 | .3216 | .3383 | .3545 | .3705 |
| 4¼ | .9244 | .9506 | .9759 | .0004 | .0245 | .0477 | .0704 | .0927 | .1143 | .1355 | .1559 | .1761 | .1959 | .2151 | .2338 | .2524 | .2702 | .2878 | .3051 | .3222 | .3389 | .3551 | .3713 |
| 4½ | .9255 | .9516 | .9770 | .0017 | .0257 | .0488 | .0715 | .0938 | .1153 | .1364 | .1569 | .1770 | .1967 | .2159 | .2348 | .2531 | .2711 | .2887 | .3060 | .3228 | .3395 | .3558 | .3718 |
| 4¾ | .9266 | .9527 | .9780 | .0026 | .0265 | .0496 | .0722 | .0945 | .1163 | .1370 | .1578 | .1778 | .1976 | .2167 | .2355 | .2538 | .2718 | .2894 | .3066 | .3235 | .3400 | .3566 | .3724 |
| 5 | .9277 | .9538 | .9791 | .0035 | .0278 | .0508 | .0734 | .0955 | .1173 | .1380 | .1587 | .1787 | .1984 | .2175 | .2363 | .2545 | .2725 | .2900 | .3073 | .3243 | .3408 | .3572 | .3731 |
| 5¼ | .9288 | .9548 | .9801 | .0043 | .0286 | .0515 | .0741 | .0962 | .1179 | .1389 | .1596 | .1796 | .1992 | .2183 | .2370 | .2553 | .2732 | .2907 | .3079 | .3249 | .3414 | .3577 | .3738 |
| 5½ | .9299 | .9559 | .9811 | .0056 | .0294 | .0527 | .0752 | .0973 | .1189 | .1399 | .1605 | .1804 | .2000 | .2191 | .2378 | .2560 | .2739 | .2916 | .3088 | .3257 | .3422 | .3585 | .3746 |
| 5¾ | .9310 | .9570 | .9822 | .0065 | .0302 | .0535 | .0763 | .0983 | .1196 | .1405 | .1614 | .1813 | .2006 | .2198 | .2385 | .2567 | .2746 | .2923 | .3094 | .3263 | .3428 | .3591 | .3751 |

| Diameter, Inches | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .3758 | .3915 | .4069 | .4219 | .4368 | .4513 | .4657 | .4799 | .4937 | .5075 | .5209 | .5342 | .5473 | .5601 | .5728 | .5852 | .5976 | .6098 | .6217 | .6336 | .6452 | .6567 |
| ¼ | .3764 | .3920 | .4074 | .4226 | .4374 | .4519 | .4663 | .4804 | .4943 | .5080 | .5214 | .5347 | .5478 | .5606 | .5732 | .5858 | .5980 | .6102 | .6222 | .6341 | .6457 | .6572 |
| ½ | .3771 | .3927 | .4081 | .4232 | .4381 | .4526 | .4669 | .4810 | .4949 | .5085 | .5221 | .5353 | .5483 | .5612 | .5738 | .5864 | .5986 | .6108 | .6227 | .6346 | .6462 | .6576 |
| ¾ | .3777 | .3934 | .4087 | .4237 | .4385 | .4532 | .4675 | .4816 | .4954 | .5091 | .5226 | .5358 | .5488 | .5617 | .5743 | .5868 | .5991 | .6112 | .6232 | .6350 | .6467 | .6581 |
| 1 | .3784 | .3941 | .4094 | .4244 | .4392 | .4538 | .4681 | .4822 | .4961 | .5097 | .5231 | .5363 | .5494 | .5623 | .5748 | .5874 | .5997 | .6117 | .6238 | .6355 | .6472 | .6586 |
| 1¼ | .3789 | .3946 | .4099 | .4250 | .4398 | .4544 | .4686 | .4827 | .4967 | .5103 | .5236 | .5368 | .5499 | .5628 | .5753 | .5878 | .6001 | .6123 | .6242 | .6360 | .6476 | .6591 |
| 1½ | .3797 | .3953 | .4106 | .4257 | .4404 | .4550 | .4692 | .4833 | .4972 | .5108 | .5243 | .5374 | .5505 | .5632 | .5759 | .5884 | .6006 | .6128 | .6247 | .6365 | .6481 | .6595 |
| 1¾ | .3804 | .3959 | .4113 | .4263 | .4411 | .4556 | .4698 | .4339 | .4978 | .5113 | .5248 | .5379 | .5510 | .5637 | .5763 | .5888 | .6011 | .6132 | .6252 | .6370 | .6486 | .6600 |
| 2 | .3811 | .3965 | .4120 | .4270 | .4417 | .4562 | .4704 | .4846 | .4983 | .5120 | .5253 | .5386 | .5516 | .5643 | .5769 | .5894 | .6016 | .6137 | .6257 | .6375 | .6490 | .6605 |
| 2¼ | .3817 | .3972 | .4125 | .4275 | .4423 | .4568 | .4710 | .4852 | .4989 | .5126 | .5258 | .5391 | .5521 | .5648 | .5775 | .5898 | .6022 | .6143 | .6261 | .6379 | .6495 | .6610 |
| 2½ | .3824 | .3979 | .4131 | .4281 | .4429 | .4574 | .4717 | .4857 | .4995 | .5131 | .5265 | .5397 | .5527 | .5654 | .5781 | .5904 | .6027 | .6148 | .6266 | .6384 | .6500 | .6614 |
| 2¾ | .3829 | .3985 | .4138 | .4288 | .4436 | .4580 | .4723 | .4863 | .5001 | .5136 | .5270 | .5402 | .5532 | .5658 | .5785 | .5910 | .6031 | .6152 | .6272 | .6389 | .6505 | .6619 |
| 3 | .3836 | .3992 | .4145 | .4294 | .4442 | .4586 | .4729 | .4869 | .5006 | .5141 | .5276 | .5407 | .5536 | .5664 | .5791 | .5915 | .6037 | .6157 | .6277 | .6394 | .6510 | .6624 |
| 3¼ | .3842 | .3998 | .4150 | .4299 | .4447 | .4592 | .4735 | .4874 | .5012 | .5147 | .5281 | .5412 | .5541 | .5669 | .5796 | .5920 | .6042 | .6163 | .6282 | .6399 | .6515 | .6629 |
| 3½ | .3849 | .4005 | .4156 | .4306 | .4453 | .4598 | .4741 | .4880 | .5017 | .5153 | .5287 | .5418 | .5547 | .5675 | .5801 | .5925 | .6048 | .6168 | .6287 | .6404 | .6520 | .6633 |
| 3¾ | .3856 | .4011 | .4163 | .4312 | .4459 | .4604 | .4747 | .4886 | .5023 | .5159 | .5292 | .5423 | .5552 | .5680 | .5806 | .5930 | .6052 | .6172 | .6291 | .6409 | .6524 | .6638 |
| 4 | .3863 | .4017 | .4170 | .4318 | .4465 | .4610 | .4752 | .4891 | .5030 | .5164 | .5298 | .5429 | .5558 | .5686 | .5812 | .5935 | .6057 | .6177 | .6296 | .6414 | .6529 | .6643 |
| 4¼ | .3869 | .4023 | .4175 | .4325 | .4472 | .4616 | .4758 | .4897 | .5035 | .5169 | .5303 | .5434 | .5563 | .5690 | .5816 | .5940 | .6062 | .6183 | .6301 | .6418 | .6534 | .6647 |
| 4½ | .3876 | .4029 | .4181 | .4331 | .4478 | .4622 | .4764 | .4904 | .5041 | .5176 | .5308 | .5439 | .5569 | .5696 | .5822 | .5945 | .6067 | .6188 | .6306 | .6423 | .6539 | .6652 |
| 4¾ | .3881 | .4036 | .4188 | .4338 | .4484 | .4628 | .4770 | .4909 | .5046 | .5181 | .5314 | .5444 | .5574 | .5701 | .5826 | .5951 | .6072 | .6192 | .6310 | .6428 | .6544 | .6657 |
| 5 | .3888 | .4043 | .4195 | .4344 | .4490 | .4634 | .4776 | .4915 | .5051 | .5186 | .5320 | .5451 | .5580 | .5707 | .5832 | .5956 | .6078 | .6197 | .6315 | .6433 | .6549 | .6661 |
| 5¼ | .3895 | .4048 | .4200 | .4349 | .4496 | .4639 | .4781 | .4921 | .5057 | .5192 | .5325 | .5456 | .5585 | .5711 | .5837 | .5960 | .6082 | .6202 | .6321 | .6437 | .6553 | .6666 |
| 5½ | .3902 | .4055 | .4206 | .4355 | .4502 | .4645 | .4787 | .4926 | .5064 | .5196 | .5331 | .5462 | .5591 | .5717 | .5842 | .5966 | .6087 | .6208 | .6326 | .6442 | .6558 | .6672 |
| 5¾ | .3908 | .4062 | .4213 | .4362 | .4507 | .4651 | .4793 | .4932 | .5069 | .5204 | .5336 | .5467 | .5595 | .5722 | .5847 | .5970 | .6093 | .6212 | .6331 | .6447 | .6562 | .6676 |

| Diameter, Inches | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .6681 | .6792 | .6904 | .7013 | .7121 | .7227 | .7333 | .7437 | .7540 | .7641 | .7742 | .7840 | .7939 | .8036 | .8132 | .8227 | .8321 | .8414 | .8505 | .8596 | .8686 | .8775 | .8864 |
| ¼ | .6686 | .6797 | .6908 | .7017 | .7125 | .7231 | .7337 | .7441 | .7544 | .7645 | .7745 | .7845 | .7943 | .8040 | .8136 | .8231 | .8324 | .8417 | .8509 | .8600 | .8690 | .8779 | .8867 |
| ½ | .6690 | .6802 | .6913 | .7022 | .7130 | .7236 | .7341 | .7445 | .7548 | .7649 | .7750 | .7849 | .7947 | .8044 | .8140 | .8235 | .8328 | .8421 | .8513 | .8604 | .8694 | .8783 | .8871 |
| ¾ | .6695 | .6807 | .6917 | .7026 | .7134 | .7240 | .7345 | .7449 | .7552 | .7653 | .7753 | .7853 | .7950 | .8048 | .8144 | .8239 | .8332 | .8425 | .8517 | .8608 | .8698 | .8786 | .8874 |
| 1 | .6700 | .6812 | .6921 | .7031 | .7138 | .7245 | .7350 | .7454 | .7556 | .7657 | .7758 | .7857 | .7955 | .8052 | .8148 | .8243 | .8336 | .8429 | .8520 | .8611 | .8701 | .8790 | .8878 |
| 1¼ | .6704 | .6816 | .6926 | .7035 | .7142 | .7249 | .7354 | .7458 | .7560 | .7662 | .7762 | .7861 | .7959 | .8056 | .8152 | .8247 | .8340 | .8432 | .8524 | .8615 | .8705 | .8794 | .8882 |
| 1½ | .6709 | .6821 | .6931 | .7040 | .7147 | .7253 | .7358 | .7462 | .7565 | .7666 | .7766 | .7865 | .7963 | .8060 | .8156 | .8250 | .8344 | .8437 | .8528 | .8619 | .8709 | .8797 | .8886 |
| 1¾ | .6714 | .6825 | .6936 | .7044 | .7152 | .7257 | .7362 | .7466 | .7569 | .7670 | .7770 | .7869 | .7967 | .8064 | .8160 | .8254 | .8347 | .8440 | .8532 | .8623 | .8713 | .8801 | .8889 |
| 2 | .6718 | .6830 | .6940 | .7049 | .7156 | .7262 | .7367 | .7471 | .7573 | .7675 | .7774 | .7873 | .7971 | .8068 | .8164 | .8258 | .8352 | .8444 | .8536 | .8627 | .8716 | .8805 | .8893 |
| 2¼ | .6723 | .6834 | .6944 | .7054 | .7160 | .7266 | .7371 | .7475 | .7577 | .7678 | .7779 | .7877 | .7975 | .8072 | .8168 | .8262 | .8356 | .8448 | .8539 | .8630 | .8720 | .8808 | .8896 |
| 2½ | .6727 | .6839 | .6950 | .7058 | .7165 | .7271 | .7376 | .7480 | .7582 | .7683 | .7783 | .7882 | .7980 | .8076 | .8172 | .8266 | .8359 | .8452 | .8544 | .8634 | .8723 | .8812 | .8900 |
| 2¾ | .6732 | .6844 | .6954 | .7062 | .7169 | .7275 | .7380 | .7483 | .7585 | .7687 | .7787 | .7885 | .7983 | .8080 | .8176 | .8270 | .8363 | .8455 | .8547 | .8637 | .8727 | .8816 | .8904 |
| 3 | .6737 | .6848 | .6958 | .7067 | .7174 | .7280 | .7385 | .7488 | .7590 | .7692 | .7791 | .7889 | .7987 | .8084 | .8180 | .8274 | .8367 | .8460 | .8551 | .8642 | .8731 | .8820 | .8908 |
| 3¼ | .6741 | .6853 | .6963 | .7071 | .7178 | .7284 | .7389 | .7492 | .7594 | .7695 | .7795 | .7894 | .7991 | .8088 | .8184 | .8278 | .8371 | .8463 | .8555 | .8645 | .8734 | .8823 | .8911 |
| 3½ | .6746 | .6857 | .6967 | .7076 | .7183 | .7288 | .7393 | .7497 | .7599 | .7700 | .7800 | .7898 | .7995 | .8092 | .8188 | .8281 | .8375 | .8467 | .8559 | .8649 | .8738 | .8827 | .8915 |
| 3¾ | .6750 | .6862 | .6971 | .7080 | .7187 | .7292 | .7397 | .7501 | .7603 | .7703 | .7803 | .7902 | .8000 | .8096 | .8192 | .8285 | .8378 | .8471 | .8562 | .8652 | .8742 | .8830 | .8918 |
| 4 | .6756 | .6866 | .6977 | .7085 | .7192 | .7297 | .7402 | .7505 | .7607 | .7708 | .7807 | .7906 | .8004 | .8100 | .8195 | .8289 | .8383 | .8475 | .8566 | .8656 | .8746 | .8834 | .8922 |
| 4¼ | .6761 | .6871 | .6981 | .7089 | .7196 | .7301 | .7406 | .7509 | .7611 | .7712 | .7812 | .7910 | .8007 | .8104 | .8199 | .8293 | .8387 | .8479 | .8570 | .8660 | .8749 | .8838 | .8926 |
| 4½ | .6765 | .6876 | .6985 | .7094 | .7201 | .7306 | .7411 | .7514 | .7616 | .7717 | .7816 | .7914 | .8011 | .8108 | .8203 | .8297 | .8390 | .8482 | .8574 | .8664 | .8754 | .8842 | .8929 |
| 4¾ | .6770 | .6881 | .6990 | .7098 | .7205 | .7310 | .7415 | .7517 | .7619 | .7720 | .7820 | .7918 | .8015 | .8112 | .8207 | .8301 | .8394 | .8486 | .8578 | .8668 | .8757 | .8845 | .8933 |
| 5 | .6774 | .6885 | .6995 | .7103 | .7210 | .7315 | .7419 | .7522 | .7624 | .7725 | .7824 | .7923 | .8020 | .8116 | .8211 | .8305 | .8398 | .8490 | .8581 | .8671 | .8760 | .8849 | .8937 |
| 5¼ | .6779 | .6890 | .6999 | .7107 | .7214 | .7319 | .7423 | .7526 | .7628 | .7728 | .7828 | .7926 | .8024 | .8120 | .8215 | .8309 | .8402 | .8494 | .8585 | .8675 | .8764 | .8852 | .8940 |
| 5½ | .6783 | .6894 | .7004 | .7111 | .7218 | .7324 | .7428 | .7530 | .7633 | .7733 | .7833 | .7930 | .8028 | .8124 | .8219 | .8313 | .8405 | .8498 | .8589 | .8679 | .8768 | .8856 | .8944 |
| 5¾ | .6788 | .6898 | .7008 | .7116 | .7222 | .7328 | .7432 | .7535 | .7637 | .7737 | .7836 | .7934 | .8032 | .8128 | .8223 | .8317 | .8409 | .8502 | .8593 | .8682 | .8771 | .8860 | .8947 |
| | | | | | | | | | | | | | | | | | | | | | | | .8951 |

Curve 3b shows graphically a few of the values given in Table 3. The plotting and method of using this curve is the same as Curve 1b.

Curve 4b shows graphically some of the values given in Table 4. This curve is plotted similarly to Curves 1b and 3b, except that the light lines, representing the corrected number of cubic feet of pulp, are in this case located above the heavy lines, since the correction is added instead of subtracted as in Curves 1b and 3b.

We are indebted to Prof. L. M. Hoskins of the Department of Applied Mathematics and to Prof. Fernando Sanford of the Department of Physics of Stanford University for several valuable suggestions in connection with this work. We also wish to acknowledge the faithful and painstaking work of E. P. Bly and G. W. Hawley in connection with the making of certain of the routine calculations.

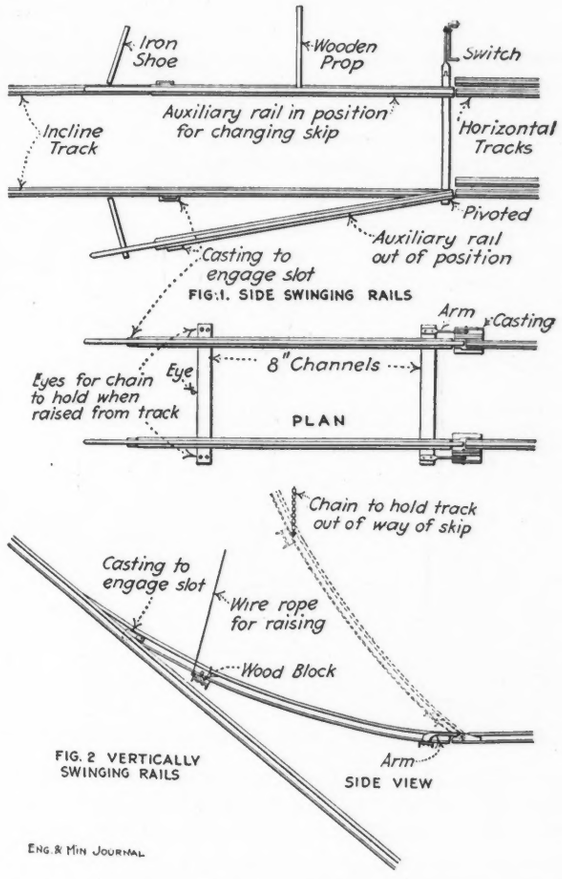
NOTE—The characteristics of the logarithms in the above table are best determined by looking up the natural number to which they refer, and calculating as is done with ordinary logarithms. These characteristics may be 3, 2 or 1. The change in the characteristic can always be told by inspection through the change in the mantissa so that with experience, the characteristic can be immediately deduced from the part of the table in which the logarithm occurs.

# Details of Practical Mining

## Skip Transfer at Incline-Shaft Collar

By Arthur C. Vivian

At the conglomerate shafts of the Calumet & Hecla, in Michigan, the skips and man cars when not in use are stored on horizontal tracks in a detached building, about 30 ft. from the shaft house proper. The conveyances are transferred from the incline tracks of the skip road to the horizontal surface tracks over short pieces of track curved in vertical section, which may be swung into place




Arrangements of Rails for Transferring Shaft Vehicles from Inclined Tracks to Horizontal

for that purpose. When not in use these sections of auxiliary track must be out of the way of skips in the shaft, and two methods of disposing of them are employed, the choice of which depends upon the weight of the skip used.

The simpler and more convenient of the two methods may be used only with a small skip, such as is in service in the scramming operations at Hecla shafts Nos. 2 and 3, this for the reason that the two rails have no lateral braeing except that afforded by the makeshift wooden prop, and a heavy skip would be likely to spread the rails in passing over them. This method is shown in Fig. 1 in plan only, but a side view would correspond exeept in details to the side view of the other method shown in Fig. 2. Rails of about 90 lb. weight are used, and they are not reinforced or connected with each other in any way except near their junctions with the horizontal track, where they are both pivoted to a switch bar so that their upper ends may be swung aside horizontally to clear the skip. The switch is used to make connection with either of two tracks, one holding the skip, the other the man car. The method is obviously applicable only to a single-skip-road shaft, as there would not be room between the adjacent, inside rails of two skip roads to allow the auxiliary rails to be swung aside. A casting riveted to each rail near its upper end projeets below it and engages a corresponding slot in the track stringer to hold the rail in place; a sprag is braced against each rail from the sides of the shaft house to prevent the rails from spreading. The rails can be thrown in and out of position easily and quickly by one man, and it is unfortunate that this simple method is not of wider application.

Where heavier skips are used the second method is employed, and this conforms in principle to that used at most of the shaft houses of the district. The two rails are connected rigidly by crossbraces, and they are hinged at their junction with the horizontal track so that their upper ends may be lifted high enough to clear the skip. The method is illustrated in plan and side elevation in Fig. 2. Most shaft houses are equipped with a pony winch for handling timber and this may be utilized in lifting the auxiliary rails, or in the absence of this accessory they may be lifted by hand. When not in use, they are suspended by chains hung from the roof.

The illustration shows a heavy rail without any reinforcement in the way of backing, but at other mines it is usual to mount the rail for part of its length on a wooden stringer. On steeply inclined tracks, such as those at the Allouez shafts and Nos. 3 and 4 shafts of the Ahmeek, where the track is inclined at 80°, this reinforcement takes the form of guides for the skip wheels, so that they will not leave the track on the sharp vertical curve used.

## Tailings Disposal in California

Tailings-disposal arrangements at all the stamp mills along the Mother Lode in Amador County in California will be completed before the end of the year, in compliance with an order of court requiring such distribution of the tailings as to prevent alleged damage to agricultural lands in Amador and Sacramento Counties. The South Eureka was the first to complete its system of flume and dam. The Kennedy followed with the installation of tailings wheels and is now completing a large dam which is an additional method of conservation that may not be actually necessary for several years. The Argonaut, adjoining the Kennedy on the south, and the Central Eureka, adjoining the South Eureka on the north, have

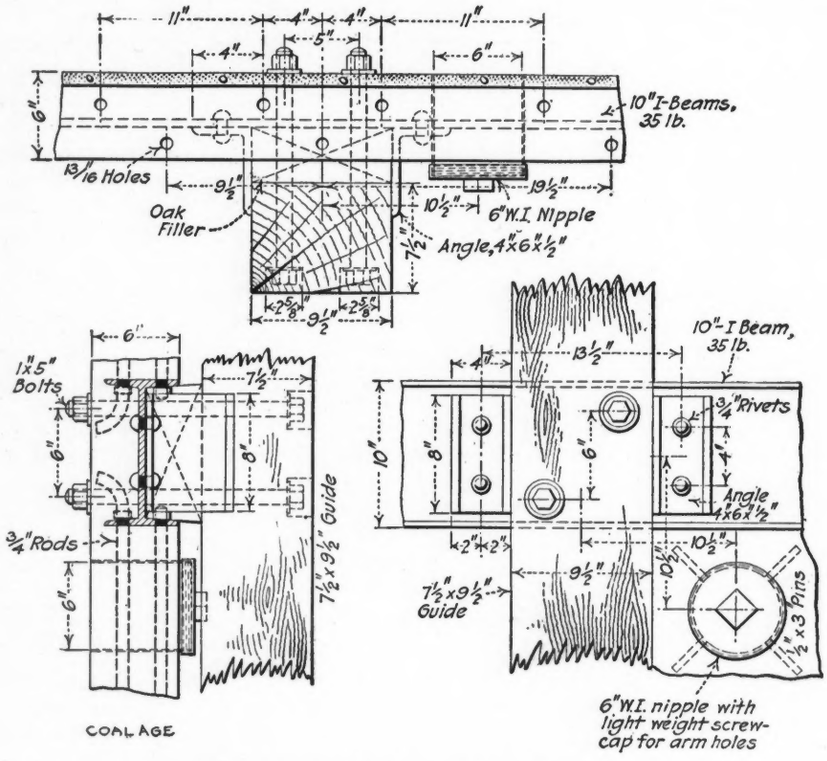
adopted the flume-and-dam system, and both are well prepared for holding the tailings for a long period of years. Extending further north, in the order named, the Keystone, Original, Amador, Bunker Hill and Fremont are likewise completing installations of flumes and dams.

## Guide Fastening to Steel Divider

An auxiliary shaft recently sunk by the Bunsen Coal Co., of Danville, Ill., is lined with concrete and divided into three compartments by means of 10-in. steel I-beam dividers. Between the cage compartment and the airway a concrete curtain wall was provided, as described in *Coal Age*.

The yellow-pine guides are 7½x9½ in. and are fastened to each divider with two 1-in. bolts. White-oak filler blocks were inserted between the guides and the webs of the I-beam dividers. At the side of the guide and below each divider on the curtain-wall side a 6-in. nipple of heavy pipe was set in the concrete and closed with a plug or cap. The nipple serves as an arm hole when it becomes necessary to reach the nuts of the guide bolts.

A space of 1½ in. was left between the back of the guide and the concrete, so that vibration might not be transmitted. The details of the connection are shown in the accompanying illustration.




Detail of Guide Connections to Buntons

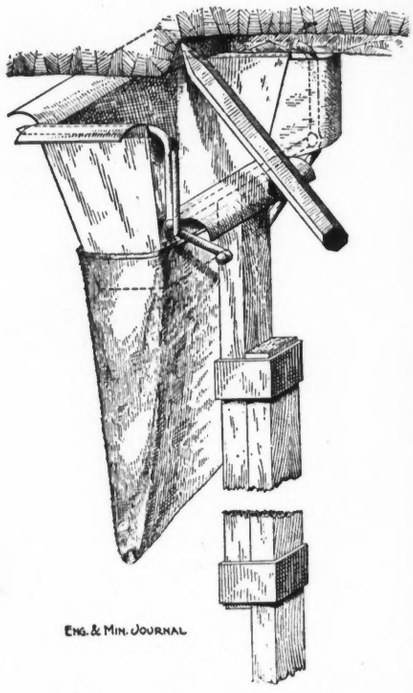
## Ash Filling on the Rand

The Witwatersrand is recognized as having carried to a higher point of development than any other metal-mining district the system of filling worked-out areas with sand. For this purpose ashes also are used. The latest annual report of the Department of Mines of the Union of South Africa notes the fact that at the Consolidated Main Reef mine, where the Vereeniging railway crosses the outcrop, the worked-out stopes have been filled with ashes which contain a considerable amount of clinker and make a satisfactory filling material. At Randfontein No. 6 section also ash filling is being resorted to for supporting the area below the railway line.

## Sample Catcher for Backs

By A. Livingstone Oke*

In the course of sampling the back of a level or other working, there is always a certain amount of difficulty in insuring that all of the material broken from the cut is collected without admixture from extraneous sources or loss from splintering. After experimenting with numerous methods and devices, I finally arrived at the simple arrangement shown in the illustration, for simultaneously collecting and bagging the material forming the sample.




Catcher in Use on Staff

It consists essentially of a two-pronged fork, the upper extremities of the prongs being bent backward, parallel to each other and at right angles to the original plane, as shown. On these bent portions of the prongs is hung a canvas or soft leather, square-sectioned funnel, which is open at the top and bottom and also has one side partly cut out. On the lower part of this funnel are four hooks from which the sample bag is hung. The upper part of the funnel has wings attached which are stiffened around their free edges by being sewn over pieces of copper wire. The metal part of the fork is attached rigidly to a wooden handle made in two pieces, arranged to slide over each other and so permit of adjustment for height.

The fork when in use is held firmly up against the back

*Mining engineer, 3 Marine Terrace, Penzance, Cornwall, Eng.

in such a way that the three upper wings press against the irregular surfaces on either side of the proposed cut, while the moil is used through the opening between the two prongs.

The material from the cut falls directly into the bag and requires no further handling. There is practically no loss from splintering, as the cut is surrounded on three sides by the funnel and the fourth side is also partly closed by the sampler's hand as he holds the moil.

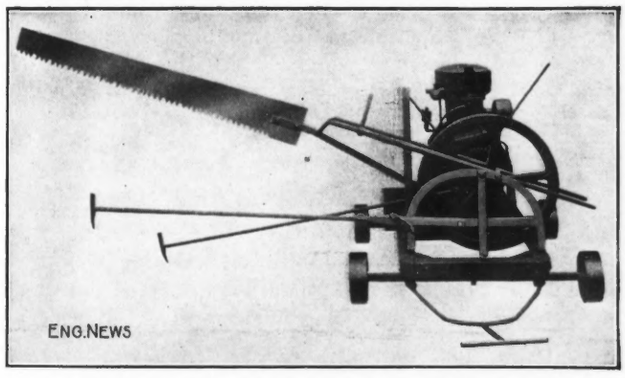
I have found that it is desirable to have some means of keeping the fork pressed tightly against the roof and this may be done by drilling holes an inch apart in the center of the upper half of the handle and using as a lever a spike resting on the top of the lower half.

In certain kinds of rock there is a tendency for large pieces to flake off from the sides of the cut and, as these do not properly belong to the sample, it is desirable to prevent them from falling into the bag. To do this it is only necessary to place a wide-spaced screen in the contracted throat of the funnel, below the level of the crossbar; or a few bars of suitable wire can be fixed across it permanently. The material of the funnel can be strong canvas or well softened goat-skin. The wings can be bent to various outlines to meet the irregularities of the roof, due to the malleability of the copper wire stiffening around their edges.

The dimensions of the whole apparatus will vary with the individual requirements, but the size shown is one I have found most convenient after several years' use, particularly in comparatively narrow workings.

## Gasoline-Engine-Driven Saw

A crosscut saw driven by a gasoline engine is built by the Whitman Agricultural Co. In a run recently it cut




PORTABLE GASOLINE ENGINE AND CROSSCUT SAW

14x14-in. timbers in one minute each, according to *Engineering News*. The engine is a 2½-hp. Sultan with clutch and gear transmission to the saw crankwheel. The saw and engine are mounted on a truck so as to be brought up easily to the timber. Dogs for holding the work are pivoted on the frame. The clutch allows throwing the saw out of action instantly.

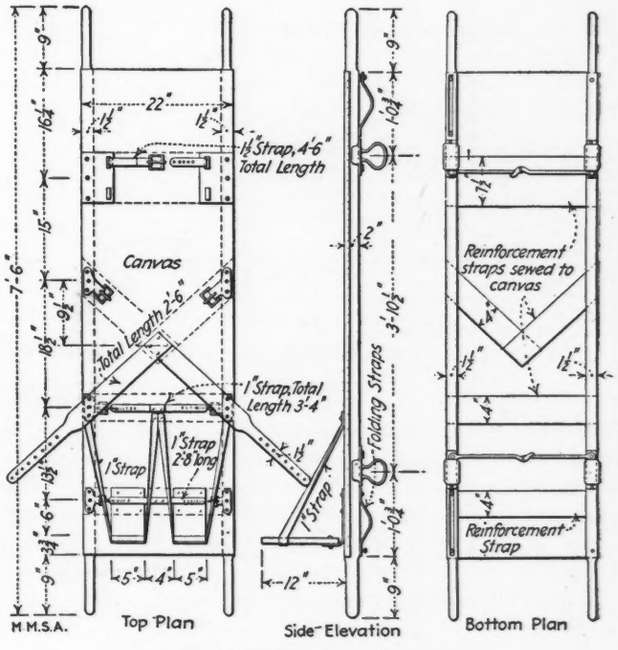
## Electric Warning Device for Hoisting Engineer

The Rogers-Brown Ore Co., Crosby, Minn., is using an electric device to warn the hoisting engineers that the skip is nearing the collar or has passed it. In the words of its inventor, J. P. Wallheus, master mechanic for the mining company, the device is intended "to keep the engineer's mind on the reverse lever and to warn him when the skips are near the dump." A 60-cp. electric lamp is mounted on a board in front of the engineer and is painted red. This lamp, reverse lever and indicator are connected to an electric circuit. The circuit is open until the skips are about 30 ft. from the dump, at which point the circuit is closed by an automatic switch attached to the indicator. This turns on the red light, showing the engineer that the skip is near the dump. The red light remains on until the engine is reversed, when the circuit is opened and the red light disappears.

Its application to the cage hoist, which does not run in balance, is as follows: The automatic drop switch is on the indicator. This switch will drop only when the cage is hoisted a little above the collar of the shaft, and at this point the red light will flash on, indicating to the engineer that he has hoisted too high or that he is going in the wrong direction, as the case may be.

## Underground Stretcher

The accompanying illustration shows a stretcher for underground use mentioned by B. F. Tillson in a recent




THREE VIEWS OF STRETCHER

*Bulletin* of the Mining & Metallurgical Society of America, as employed at the Franklin Furnace mine of the the New Jersey Zinc Co.

## Chart for Platting Dips

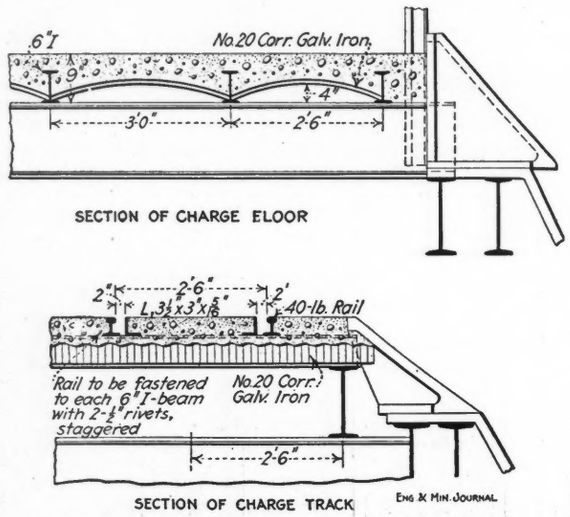
In the JOURNAL of Oct. 24, 1914, p. 740, there appeared an article having the above title. This was taken from an article by Howland Bancroft, in the *Bull. of A. I. M. E.*, July, 1914. Through inadvertence, proper credit for this article was not given in the JOURNAL. Such acknowledgment is made herewith.

# Details of Milling and Smelting

## Concrete and Steel Charge Floor

By Percy E. Barbour*

Much trouble was experienced at a Tennessee smelting plant by reason of ore dropping through chinks in the feed floor, close to the blast furnace, where castings and pipes prevented joints from being dirtproof. A shower of dust on the back of his neck would effectually dampen and restrain the efforts of the man below punching the tuyeres, and a piece of ore the size of a walnut would make a bad cut. Finally something had to be done. The




Galvanized-Iron-and-Concrete Blast-Furnace Feed Floor

old charge floor was replaced with a new one having arches of corrugated galvanized steel covered with concrete. This made it possible to make a perfectly dustproof charge floor at the odd corners of the furnace castings and no further trouble was had with the tuyere punchers on this account. The floor was durable and satisfactory in every way.

## Rubber-Belt Data

Some interesting suggestions and data on the use and selection of rubber drive belts are given in a booklet on "Mechanical Rubber Goods," issued recently by the Goodyear Tire & Rubber Co., Akron, Ohio.

Not more than a 5-ply belt should be used on an 18-in. pulley, a 6-ply on a 24-in., and an 8-ply on a 36-in. pulley. The pulley face should always be wider than the belt. Large pulleys are desirable, since the larger the pulley, the less strain is there on the belt.

Four-ply rubber belt is equal to a single leather belting. Six-ply rubber belt is equal to a double leather belting. Rawhide lacing is preferable to clamps or hooks. In case a step splice is used, run the belt *with* the splice rather than *against* it. If dressing is required, use boiled linseed oil. Avoid the use of cross belts if possible. Cut ends square and the belt ⅛ in. per ft. shorter than the measured length around the pulleys.

The following is a simple method of obtaining the horsepower of a belt: Multiply together the number of plies in the belt, its width in inches, the pulley diameter in inches, and the speed in number of revolutions per minute, then divide by 12,000. To find the proper weight belt to be used, multiply the horsepower by 12,000 and divide by the product of the belt width in inches, the pulley diameter in inches and the pulley revolutions per minute.

To find the width and weight of belt, multiply the horsepower by 12,000; multiply the pulley diameter in inches by the r.p.m.; divide the first by the second and then divide by various numbers of plies till a desirable corresponding belt width is secured. To find the speed necessary, other conditions being fixed, multiply the horsepower by 12,000 and divide by the product of the number of plies in the belt, the width of the belt in inches, and the pulley diameter in inches.

To compute the length of an endless belt, add the sum of the diameters of the pulleys in feet, multipled by 1.57, to twice the distance from center to center of the pulleys. To this add the difference in the diameter of the pulleys multiplied by itself and divided by four times the distance from center to center. When ordering endless belts, always give steel-tape-line measurements about the pulleys, or the exact figures.

## General Considerations Concerning Copper Leaching

The introduction to Stuart Croasdale's paper, "Leaching Experiments on the Ajo Ores," read at the Salt Lake meeting of the American Institute of Mining Engineers, is a good epitome of the underlying factors considered in choosing a copper-leaching process. The following are excerpts from this portion of his paper which apply to low-grade deposits of mixed oxide and sulphide ores in an arid region.

### Methods of Treatment

It will be seen that the problem demands simplicity of process and large scale of operations. Whether the ore should be taken to water or water brought to the ore is a factor to be considered, and may depend to a certain extent on the method of treatment adopted, when freight and fuel costs are estimated.

Methods of leaching with solutions of reducible salts, like ferric sulphate, ferric chloride and cupric chloride, have some advantage in their solvent power on cuprite and chalcocite or other intermediate sulphides, but have little action on chalcopyrite. These salts are expensive and their value as commercial solvents depends upon their regeneration by some cheap method of oxidation

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after the disssolved copper has been precipitated. This difficulty has not yet been overcome, nor have those of the sulphurous acid and ammonia processes.

Two reliable methods, however, are available. One of these is the old Henderson process of roasting with salt, and the other is leaching the raw ore with sulphuric acid. Under the former, I include the so called sulphatizing roast of Wedge, and the modification used at Anaconda.

A comparison of these two methods may be made briefly as follows: With the chloridizing roast, all ores could be treated by the same process. This would mean the construction of only one plant. The average extraction of the copper would probably be higher than with acid leaching, and the small amount of silver in the ore would be largely recovered. By mixing the ores, little if any sulphur would have to be added as pyrite. The only chemicals required would be salt, to the extent of 5 to 10% of the ore treated, and possibly a small amount of pyrite ore. There would be less corrosive solutions to handle. There would be a minimum amount of iron and alumina passing into solution. There would be no appreciable absorption of copper by slimes.

On the other hand, this method would require dry crushing of the ore to 20 or 40 mesh, which would be troublesome if not prohibitive on the oxidized ores on account of the difficulty in controlling the poisonous dust, in addition to the expense of grinding. It would involve a roasting cost. It would mean a more expensive plant, and a more extensive plant for the same capacity, due to the slower percolation of the fine material, which would require a much larger vat area of less depth to hold the tonnage required. It would mean a supply of cheap salt. A chemical precipitant would probably have to be used to recover the copper.

By leaching with sulphuric acid, the oxidized ore can be treated raw and need not be crushed finer than ½ in. or 2-mesh size. Sulphuric acid can be made as a by-product at a roasting plant, or if the calcines are converted into sponge iron and used as a precipitant for copper, the low-grade pyrite can be cheaply transported and acid made at the mine.

On the other hand, sulphuric acid alone will extract none of the copper existing as sulphide, only half of the copper existing as cuprite, and may be indifferent about the silicate of copper. It will extract none of the precious metals. Considerable iron and alumina pass into solution as readily as the copper, which will seriously interfere with any form of electrolytic precipitation and render the amount of acid regenerated a doubtful asset when compared with the amount consumed. As an offset to this objection, some of the iron is in a ferric condition, which assists materially in the solution of the minerals mentioned above.

If acid is made elsewhere than at the leaching plant, it will have to be transported in tank cars, which will have to be returned empty. If acid is made at the mine from low-grade pyrite, a gain will be made in transportation, but the cost of an acid plant will be added to the cost of the leaching plant and the calcines will have to be utilized. Almost an entirely new plant will have to be constructed for treatment of the intermediate and sulphide ores. The problem is clearly one in arithmetic as well as metallurgy.

## Repairing Pipe Leaks

I have found the following repairs successful, says James E. Noble, in *Power*. A 4-in. cast-iron pipe broke apart under a building foundation. To have the water on again as soon as possible, I used the clamp *A*, 6 in. wide and ¼ in. thick (Figs. 1 and 2), with sheet-rubber packing wrapped around the pipe, and two pieces of sheet copper *D* and $D_1$ 6 in. wide, where the edges of the clamp came together. This job was done seven years ago and is still satisfactory.

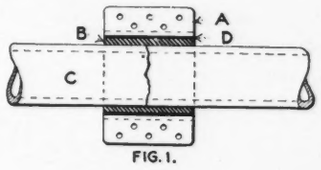


FIG. 1.

FIG. 2.

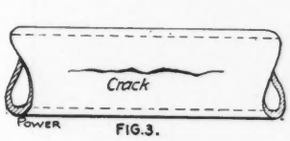


FIG. 3.

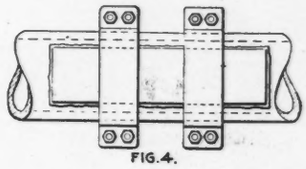


FIG. 4.

BROKEN PIPES CLAMPED

Another 6-in. cast-iron water pipe had a 15-in. crack, Fig. 3. A piece of ¼-in. iron 4 in. wide formed to the shape of the pipe, with sheet rubber placed under it, was clamped over the break, Fig. 4. This has also proved successful.

A 3-in. steam pipe leaked at the flanges, because the threaded ends were badly corroded. A copper sleeve and a 5-in. pipe 8 in. long were slipped over the opening after the flanges were removed, Fig. 5. The space between the outside of the 3-in. pipe and the inside of the 5-in. pipe was then filled with Smooth-On, iron and elastic cement mixed. Heat from a blow-torch was then applied for half an hour, and in two hours steam was turned on.

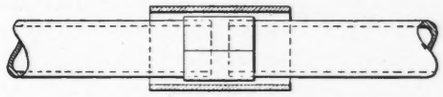


FIG. 5.

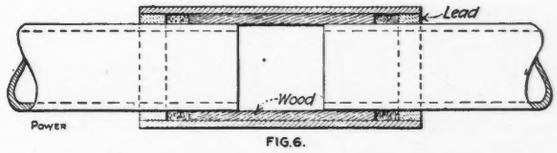


FIG. 6.

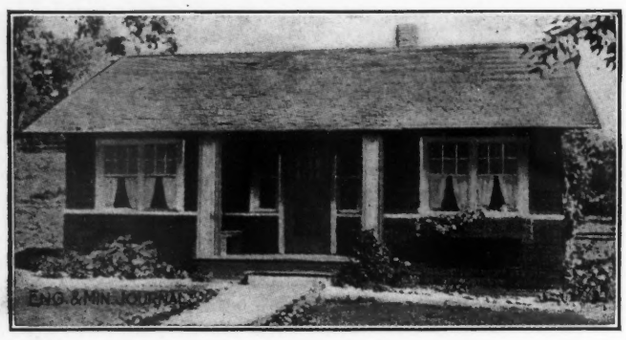
PIPE ENDS JOINED WITH SLEEVES

In extending a cast-iron water main it was found that what should have been the connecting length was a foot short and there was no more pipe of the same size on hand. Instead of sending to the city for a pipe and sleeve, one of the men went into the workshop and in a few minutes turned out a wooden sleeve 16 in. long to fit over the pipe. Next a 20-in. piece of larger pipe was cut and placed over the pipe ends and the wooden sleeve, Fig. 6. The joint was then run with lead in the usual way.

# Mining & Metallurgical Machinery

## Ready-Made Houses

Building a house is usually considered a question of proper combination of art and money in the thickly populated districts, but in the mining camps it is likely to be anything for a shelter. Inconvenience and ugliness are characteristics of the camp dwelling, added to which it




A Ready-Made Home

is usually expensive. A way to obviate these difficulties, however, is presented by the North American Construction Co., of Bay City, Mich., makers of Aladdin houses. This company controls a number of lumber-producing plants, and has built up a business in furnishing all the requirements for a complete building, the material being all cut to proper dimensions for immediate erection.

It is, in effect, a "knock-down" house, but not what is generally known as a "portable" house, since the latter class is intended for removing from one site to another. Aladdin houses seem particularly adapted to mining camps, since the designs run from the simplest workman's cottage to the pretentious home of the manager, embracing all grades between. They are reasonable in cost and great time savers, as they can be erected quickly. Every piece is marked in a way to show its use and location, just as structural steel is prepared and marked in the shop for erection.

## A Small Refrigerating Apparatus

The Montclair Refrigerating Corporation has brought out a small refrigerating apparatus that ought to be a boon for the mess houses and club houses of mining companies operating in tropical countries or in any region where ice be not easily available. The apparatus is a self-contained machine comprising an electric motor and a rotary compression pump. The refrigerating agent is ethyl chloride. The pump compresses the gas in an upper or condensing cylinder. The liquid is sent through an expansion valve into a coil where it expands into a gas again (causing refrigeration), the gas being drawn back to the compressor, thus completing the cycle of operation.

The apparatus is easily fitted to any ordinary ice box, the expansion coil being dropped in through a hole cut in the top so as to take the place of a cake of ice. It is also fitted with means for giving a supply of ice for table purposes.

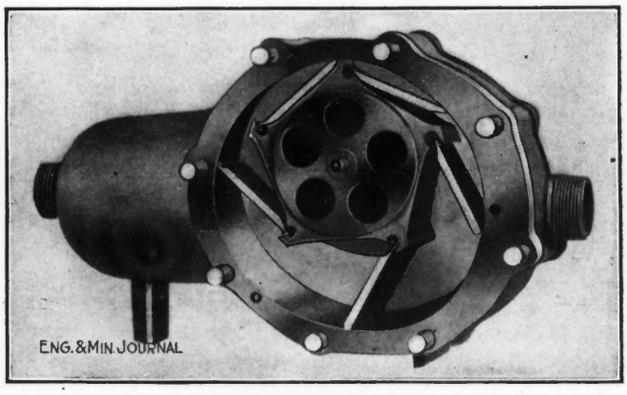
The apparatus is made in three sizes, the smallest requiring a ⅛-hp. motor and the largest a ½-hp. motor. The smallest apparatus costs $165; the largest $325. In its operation the apparatus is automatic, being controlled by a thermostat.

## Compressed-Air Meter

A meter which measures easily and accurately the amount of compressed air being used by any tool or flowing through any pipe line is an instrument which should find much use and favor among mining men. The Kreutzberg Volumetric Meter, placed on the market recently by J. S. McChesney & Co., Chicago, is designed to do this.

The meter operates on the principle that if the flow of a fluid through a container be divided into sections of definite volume and the number of sections be recorded as they pass a given point in a given time, the result is the velocity and volume of the fluid.

This illustration shows a cross-section of the meter. The flow of the air is divided mechanically into sections of definite volume and the number of revolutions of the drum is recorded on a register which gives direct readings of the flow. The pressure on each side of the vanes is theoretically the same, and in practice differs only by the energy required to rotate the drum. In pressures greater than five pounds this amount is negligible. The wear on the vane is at the end




Compressed-Air Meter

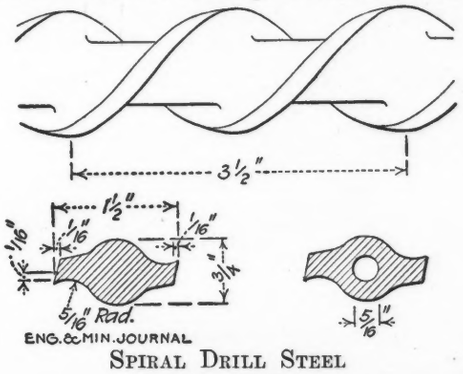
and this is automatically taken up. The energy actually required to operate the meter is a small fraction of an ounce.

The machine is constructed entirely of phosphor bronze, to prevent erosion, and the machining is accurate to within 0.00025 in. The meter is made in sizes capable of recording capacities from 0 to 75 to from 0 to 700 cu.ft. per min. The former is made for a ½-in. and the latter

for a 2-in. pipe connection. Larger sizes can be made. Not alone air but such commodities as oil, alcohol, turpentine, gas and steam under high pressure can be rapidly measured in commercial quantities with this meter, but its possibilities for mines in connection with the measurement of compressed air are unusually interesting. Undoubtedly, much efficiency is lost in the utilization of compressed air in rock drills. Up to date, so far as known, there has been no ready means of determining just exactly the amount of air a drill uses under any given conditions: the air it is using today as compared with a month ago, etc. It is quite likely that many drills do very inefficient work, as regards consumption of air, six months after being installed. If they are merely overhauled generally at regular intervals or specific repairs made, it does not follow that the drill as repaired is consuming the amount of air it should, unless the drill has been positively tested, under the same conditions, before and after. The Kreutzberg meter can be cut in on the line of any drill. It would seem that efficiency engineers, particularly, should be interested in this machine.

## Spiral Drill Steel

Spiral steel has long been used in coal mining, where it serves for making coal augers, but in metal mining there has been no use made of it, except to a small extent recently in iron mining. Believing that it may have some advantages in hard-rock work, the Forsbacka works, of Sweden, makers of the well known Fjab steel, have produced a rolled spiral shape which is now offered for trial. The accompanying illustration shows one form of the spiral bar in detail. It may be had solid or hollow, as desired. Many other variations of special bars are made. A. Milne & Co., 745 Washington St., New York, are American sales agents for all the Fjab steel products.



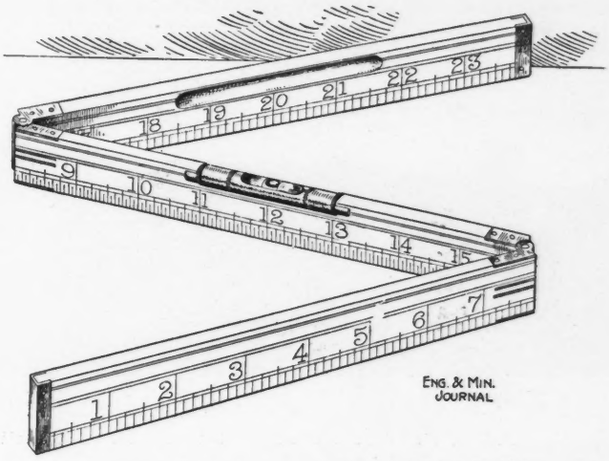

SPIRAL DRILL STEEL
Solid and Hollow.

## New Jackhamer Auger Record

In the JOURNAL of Oct. 24, some results were given of operations with the Ingersoll-Rand Jackhamer auger drill at the Cavour mine on the Mesabi range, Charles H. Claypool, superintendent. It was stated that previous to the installation of the auger drills, the production ran about 3.75 tons per man for every man employed, while with the new drills and mining system this figure was increased to 5.25 tons. Since then, Mr. Claypool has advised that the tonnage figure has been increased still further. The average production, including all surface men, even himself, has reached as high as 6½ tons.

## A Combination Pocket Rule and Level

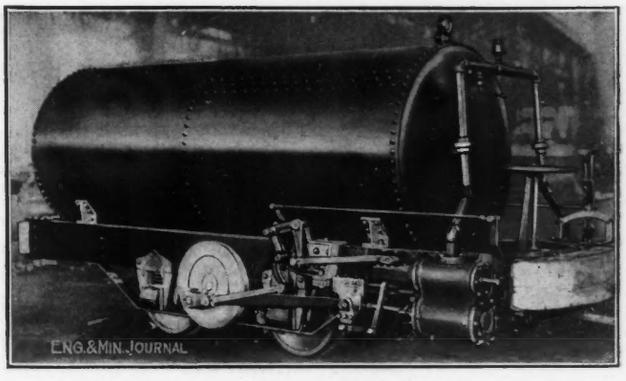
The Lufkin Rule Co. has brought out an ingenious pocket rule and level, which is shown in the accompanying engraving. When folded it is but 8 in. long. When open it is 2 ft. The joints being stiff, this affords a long base. The design of this instrument is ingenious, and being substantially made, it is a practical tool in every way.




LUFKIN COMBINATION RULE AND LEVEL

## Compressed-Air Locomotive for Victoria Mine

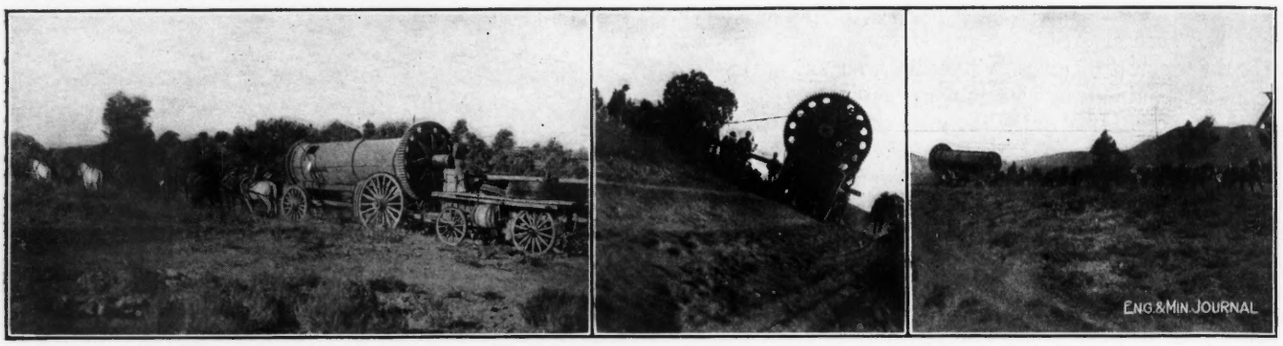
The JOURNAL for Sept. 12 contained an article describing a compressed-air locomotive which the Lake Shore Engine Works, Marquette, Mich., built recently for the Victoria Copper Mining Co., in the copper country. This locomotive is shown in the accompanying illustration. It was constructed according to the designs of George Hooper, superintendent of the mining company, and is the first low-pressure air locomotive ever built for use in the Lake Superior copper mines.




COMPRESSED-AIR LOCOMOTIVE FOR VICTORIA MINE

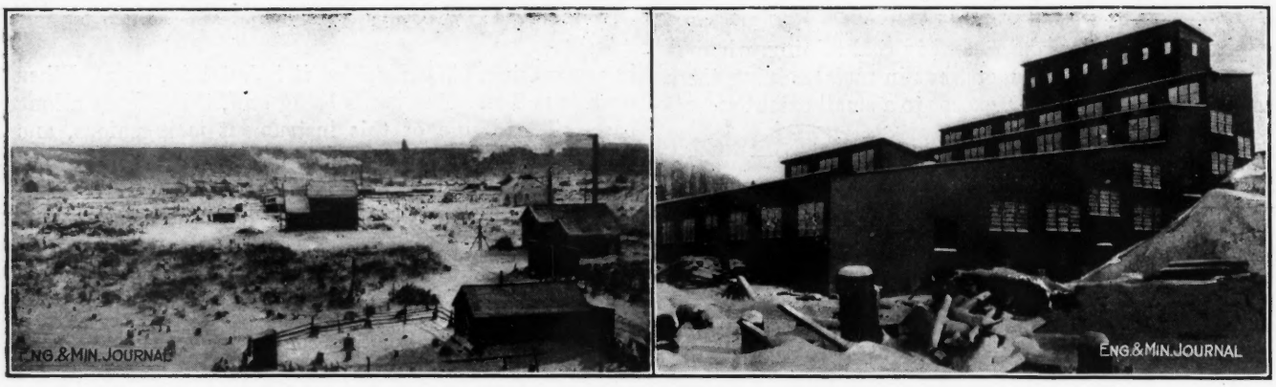
**A New Dipper Handle for Dredges** and steam shovels is composed of two steel channels placed with their flanges inward and welded together, so that they form a single member of rectangular box section. The design is patented and is being introduced by the American Steel Dredge Co., of Fort Wayne, Ind.

# Photographs from the Field




GETTING A LARGE TUBE MILL INTO MANHATTAN, NEV.

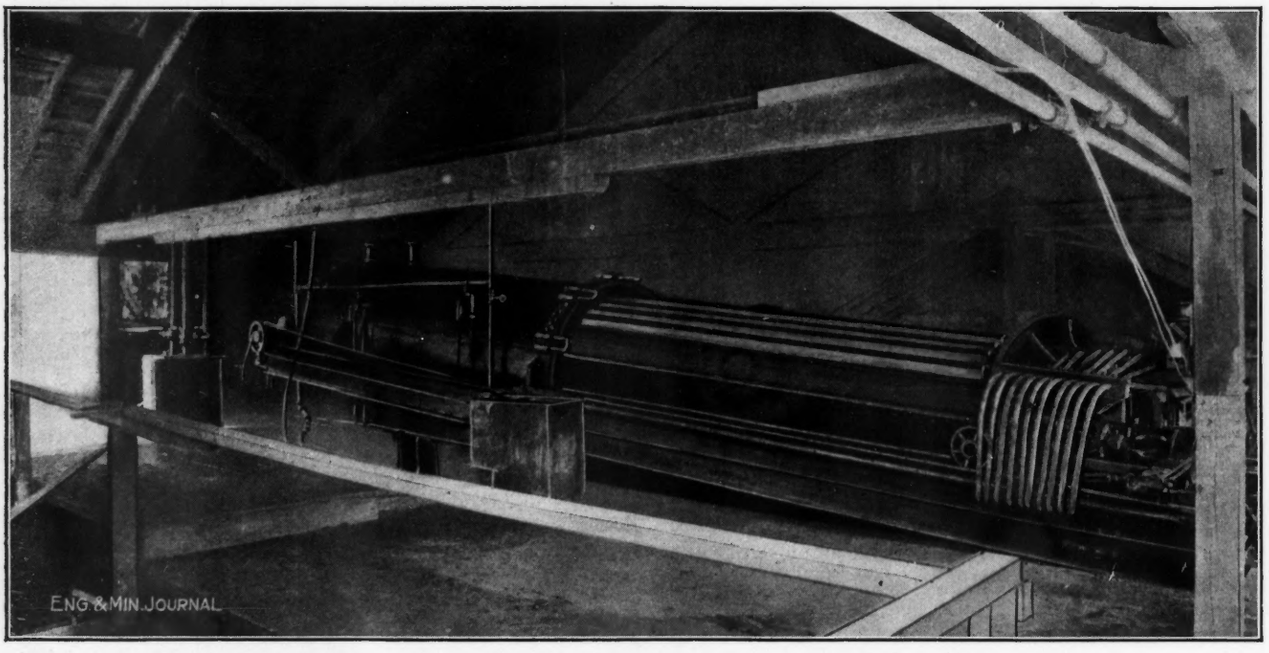
**A 5x20-ft. mill for the Big Pine ground. The shell weighs 14 tons, and is drawn by a team of 18 horses.**




THE WHITE PINE COPPER CO.'S PROPERTY, ONTONAGON, MICH.

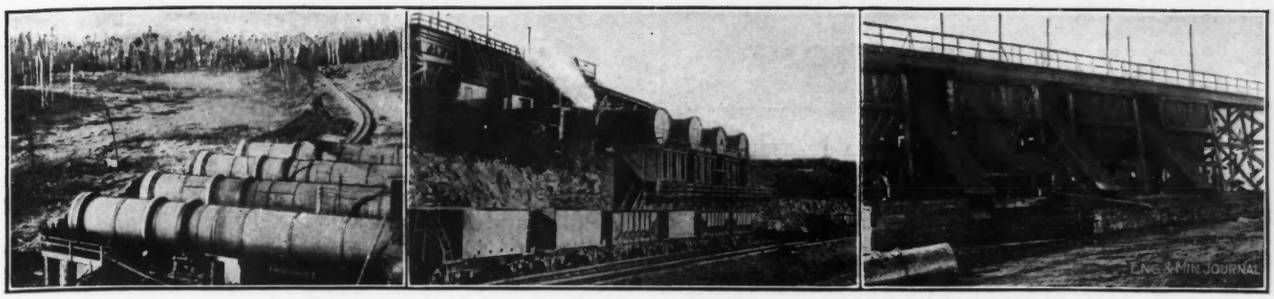
**General view, showing the shaft houses, boiler house and residences.**

**The new stamp mill having 1000 tons daily capacity. Crushing plant is behind the building.**



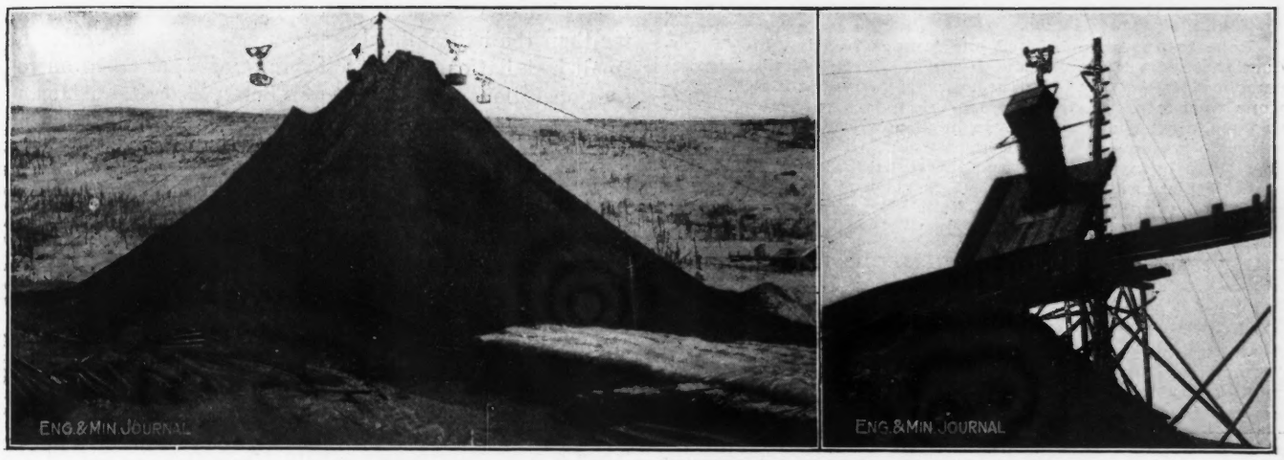

A 100-TON KELLY FILTER PRESS AT BUTTE & SUPERIOR COPPER CO.'S MILL, BUTTE

**Three of these presses are installed and are used for drying flotation concentrates.**



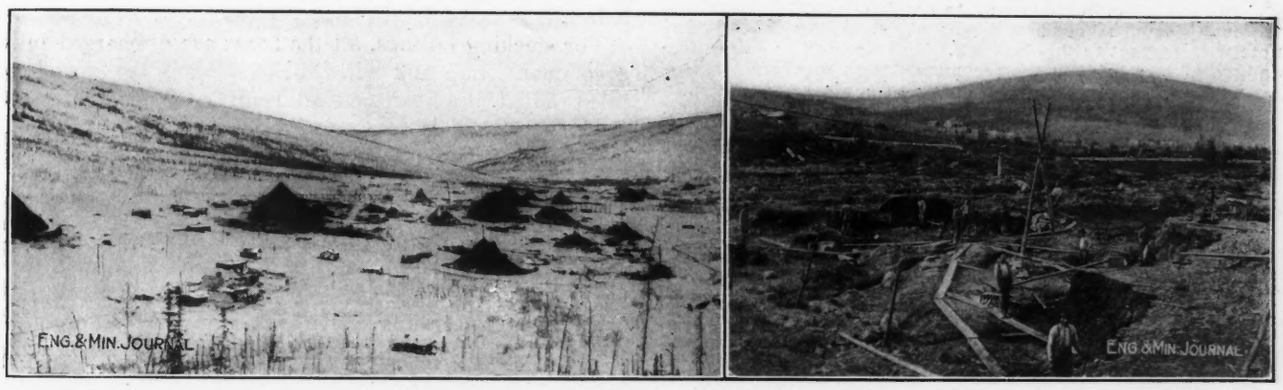

WHITESIDE DRIER INSTALLATION ON THE MESABI RANGE

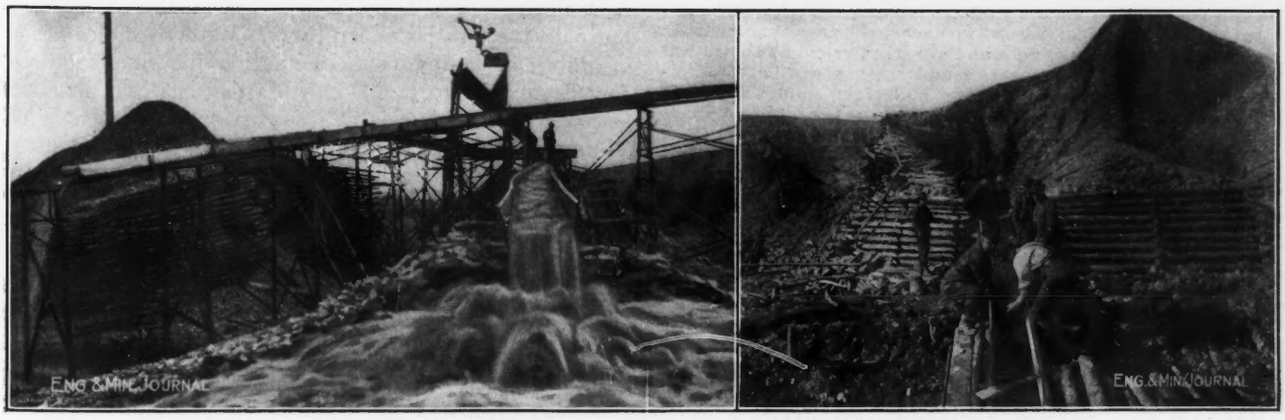
Rotary tubular drier reduces moisture from about 16% to 7 or 8%. Ore issues principally in agglomerated balls. Each drier, 9x75 ft., handles 50 to 75 tons per hour. Photographs show the driers, the dry ore discharge into cars, and the coal chutes in the rear.




GRAVEL HANDLING IN THE FAIRBANKS DISTRICT, ALASKA

A single ginpole serving for four gravel buckets. Dumping gravel into the sluice head.




GRAVEL-WASHING OPERATIONS AT FAIRBANKS, ALASKA

Winter dumps ready for spring sluicing. Sluiceway, and bucket dumping on apron.

Old opencut mining system, using wheelbarrows. The cleanup after sluicing part of a winter dump.

## NEW PUBLICATIONS

THE STONE INDUSTRY IN THE UNITED STATES IN 1913. By Ernest F. Burchard. Mineral Resources of the United States, 1913, Part II. Pp. 126, illus. U. S. Geological Survey, Washington, D. C.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, VOL. VI, 1913. 6¼x9¼, pp. 268, illus. Published by the Institute at the office of the Secretary, Cooper Union, New York.

PETROLOGY AND MINERAL RESOURCES OF JACKSON AND JOSEPHINE COUNTIES, OREGON. By A. N. Winchell. "The Mineral Resources of Oregon, Vol. I, August, 1914." Pp. 265, illus. Oregon Bureau of Mines and Geology, Corvallis, Oregon.

ROBERTS-AUSTEN. A RECORD OF HIS WORK. Compiled and Edited by Sydney W. Smith. 9x6½, pp. 382, illus. Charles Griffin & Co., Ltd., London: J. B. Lippincott Co., Philadelphia.

Roberts-Austen published one famous treatise, his "Introduction to the Study of Metallurgy," which immediately became a classic of the literature. Apart from this his contributions were confined to papers presented to several scientific and technical societies. These have now been collected in a memorial volume by one of his former assistants, who prefaces them by appreciative and interesting biographical notes of their distinguished author. Roberts-Austen is one of the great names in metallurgy and it is fitting that there should be this memorial to him.

THE DEPOSITS OF THE USEFUL MINERALS AND ROCKS. Vol. I. By F. Beyschlag, J. H. L. Vogt, and P. Krusch. Translated by S. J. Truscott. Pp. 514, illus. MacMillan & Co., London. Price, $5.

The very important treatise on ore deposits by professors Beyschlag, Vogt and Krusch has already been reviewed in the "Journal." It is satisfactory that S. J. Truscott, a well known mining engineer of London, is making it available to those geologists and engineers who do not read German. His translation is well done. There will be three volumes.

STRUCTURAL ENGINEER'S HANDBOOK. DATA FOR THE DESIGN AND CONSTRUCTION OF STEEL BRIDGES AND BUILDINGS. By Milo S. Ketchum. 6x9¼, pp. 896, illus., leather; $5. McGraw-Hill Book Co., New York.

We have often had occasion to speak favorably about Professor Ketchum's books, and we do not have to change our note with respect to this last one. Its title is fully descriptive and we will be brief in the recommendation to every structural engineer to get it. This applies to engineers engaged in mining and metallurgical constructions as well as other kinds. What amazes us about Professor Ketchum is his ability to turn out excellent work with such rapidity. His publishers list six important treatises and hand-books that have appeared in less than a dozen years. Besides his engagement in the preparation of these, Professor Ketchum is Dean of the College of Engineering and Professor of Civil Engineering in the University of Colorado, and is a consulting engineer with a considerable practice in Denver. The evidences of his industry excite universal admiration.

THE SAMPLING AND ASSAY OF THE PRECIOUS METALS: COMPRISING GOLD, SILVER, PLATINUM, AND THE PLATINUM GROUP METALS IN ORES, BULLION, AND PRODUCTS. By Ernest A. Smith. 6¼x9, pp. 460, illus.; $4.50. Charles Griffin & Co., Ltd., London, Eng.

The chapter headings are: Introductory; design and equipment of assay office; assay furnaces; furnace implements; balances and weighing; gold and silver, physical and chemical properties; valuation of ores, sampling; preparation of samples for assay; fluxes and other materials employed; principles of fluxing; assay of silver ores; assay of gold ores; assay of complex ores; special methods of ore assay; bullion, valuation and sampling; assay of gold bullion; assay of silver bullion; assay of base bullion: assay of industrial gold and silver alloys; assay of metallurgical products; assay work in a cyanide mill; platinum and metals of the platinum group; the assay of platinum.

In general this book is stronger on the assaying than it is in sampling. The questions of the accuracy of machine sampling and wherein the chances of error lie, are treated in a very perfunctory manner. The sampling of copper bullion is barely touched upon, and antiquated and worthless methods given. The sampling of precious-metal bullion is treated in much better style, but the American sampler, except in offices where gold-silver alloys, sweeps, etc., form the bulk of the work, has little to learn from this book.

The assay methods are of a higher standard, but even there, the methods for copper bullion are poor; the sulphate method not being touched upon at all.

# Hydraulic Mining at Circle

By Hubert I. Ellis*

Handling gravel by means of the hydraulic giant has never found wide application in the interior of Alaska, chiefly owing to the low gradients of most of the creeks, the difficulty and expense of obtaining sufficient water during the dry season, and the depth of bedrock. Except at Valdez Creek, which is not in the Yukon drainage, the only really successful installations have been in the Circle district, and possibly in the Fortymile. Some six or eight small plants were in operation last season in the vicinity of Circle, most of them small and comparatively simple. It is the usual practice to elevate the tailings with one of the giants, since this requires less water than the hydraulic elevator and is more applicable to small installations. The following notes are based on recent operations at the plant of Theron E. Fell, on Mastodon Creek, Circle district.

The ditch system carries an average of four sluice heads of water about 4 cu.ft. per sec. to the penstock, which delivers it to the mine under a head of 100 ft. The penstock is 2500 ft. long and includes 1000 ft. of 14-in. pipe and 1500 ft. of 10- and 8-in. pipe. The equipment includes four gates, two No. 1 giants, and one No. 2 giant.

The sluice boxes are 30 in. wide and are all fitted with simple block riffles, except one that has patent riffles and undercurrent for saving fine gold. Since the gravel is thoroughly washed before entering the sluice, it has been found that six boxes, each 12 ft. long, are sufficient. They are set near bedrock, with an open sluiceway to remove tailing. The operators are able to ground-sluice a cut 200x175 ft. and 8 ft. deep into and through the boxes before it is necessary to do any piping.

For stacking tailings, all the boxes are discharged into a common sump and with a No. 2 giant the gravel is piled 35 ft. high without difficulty. When water is slack, a bottomless scraper of 1 cu.yd. capacity is used to assist the giant; this is seldom necessary, however.

The depth of the alluvial material is about 9 ft.; from 2 to 4 ft. of coarse, slabby bedrock is also removed, making a total average depth of 12 ft. of material handled. With a 100-ft. head of water, it is possible to raise fairly heavy slabs of bedrock and to work the ground absolutely clean without crevicing. Men with wheelbarrows are employed to remove the larger boulders and pieces of bedrock. It is immaterial whether the ground is partly frozen or not, since in working frozen material the giants move all that the boxes can carry. With six sluice heads of water, excluding from calculation the time required for cleaning bedrock, 600 cu.yd. a day has been handled in partly frozen material. This corresponds to a duty of 2½ cu.yd. per miner's inch per day of 20 hr., but it must be remembered in making comparisons that the head is only 100 ft. and that part of the water is used in stacking tailings.

When water is plentiful the day shift consists of three nozzle men and two rock wheelers, while the night shift consists of three nozzle men and one rock wheeler working part of the time. When water is low and the reservoirs are brought into play, three men work each shift, wheeling rock, making repairs, etc., while waiting for the reservoirs to fill.

*Mining engineer, 4352 Ninth Ave. N. E., Seattle, Wash.

In a typical season, operations on the first cut began May 14, before the surface ice had entirely disappeared, all work being done in frozen material. The cut, 150x 170 ft. and 12 ft. deep, was cleared by June 2, a total of 20 days, at an expenditure of 165 shifts of labor, representing $1290 for wages and board. Measurements show that 11,552 cu.yd. of gravel was removed, an average of nearly 600 cu.yd. a day; the operating cost was about 12c. per cu.yd. Later in the season, when low water forced intermittent operations, the cost averaged from 14 to 17c. per cu.yd., and when the water was at the lowest stage the cost rose to 21c. These figures represent operating expenses only, no charge being made for superintendence, interest, depreciation, or for moving and setting up the plant.

It has been proved that small hydraulic plants are best for the interior of Alaska, since they can be operated at low stages of water when a larger plant would be partly or wholly idle. Their low first cost and ease of installation are also important advantages where capital is limited and the workable deposits of gravel comparatively small. This is well illustrated by the work done by the Berry interests in the Bonnifield district, where $100,000 was lost in attempting to install and operate a fairly large plant; the greatest trouble here came, however, from the periodic failure of the ditch system. The same trouble has been met throughout the North where ditches are made in muck and other frozen material, but the general experience has been that after two or three years they cease to be so troublesome. The development of tailings congestion, added to ditch difficulties, led to the abandonment of this undertaking.

## The International Zinc Convention

According to the *Borsen Zeitung* (Berlin), through the *Chemical Trade Journal,* it appears that the dissolution of both the International Zinc Convention and of the German Zinc Verband is imminent, the war having made it impossible to carry out a large number of the contracts previously entered into.

The International cartel consists of three groups—viz., the German Association, including the majority of the Belgian works, which were largely founded on German capital, the French group, and the English works.

The German-Belgian group has the character of a definite cartel, fixing both price and output, while the French and the English works are only associated in so far as determination of output is concerned. The German group, to which the most important Austrian works also belong, is responsible for about one-half of the world's total production of zinc and nearly three-quarters of the European output.

Certain German works which had announced their determination to secede from the German union at the end of 1914, now take up the attitude that, owing to the outbreak of war, and consequent falling away of the English and French groups from the International Convention and also the inability of the Belgian works to carry out their contracts, not only the International Convention, but also the German association, is to be regarded as dissolved. This point of view is not accepted by another portion of the German works, which contends that contracts are not rendered void by the war, but merely are suspended. It is at present uncertain whether the whole question will be contested at law.

[The matter of contracts for ore supplies, sales of metals, etc., that have been interrupted by the war, is a very bitter subject among the respective parties, especially if they happen to be of hostile nationalities, and many hard feelings are developing in this way.—EDITOR.]

## Samuel Benedict Christy

BY R. W. RAYMOND

The death of Prof. Samuel Benedict Christy on the 30th of November, at the age of 61 years, cuts short a brilliant and influential professional career. He was born in San Francisco, Aug. 8, 1853, and was graduated as Bachelor of Philosophy at the University of California in 1874. For the five years that followed, he studied


SAMUEL BENEDICT CHRISTY

mining and metallurgy as a post-graduate in the same institution, serving also as instructor in analytical chemistry, and becoming in 1879 instructor in mining and metallurgy—a position which he held until 1885. During this period he became known also by his contributions to technical literature, the earliest of which, perhaps, was his report on the Monte Diablo coals (in 1875); but the first which drew my attention to him was an exceedingly able discussion (in 1879) of the genesis of the quicksilver deposits of California, in which he followed with much acuteness and originality the lead of Professor Becker, who had been teaching at the University of California. The notion of the thermo-aqueous formation of such deposits was then new; and the laborers in a field

now familiar to every student deserve the credit due to pioneers.

For some years the subject of quicksilver seems to have occupied much of Christy's attention. In 1877, he described the mines and works at Almaden, Spain; in 1884, the Imperial quicksilver works at Idria, Austria; in 1889, the New Almaden mines of California.

But his great work was the creation of the school of mining and metallurgy at the University of California, which may be said to have begun with his occupancy of a full professorship of these branches. It is not necessary here to recount the early difficulties and perils of the University, and its long struggle for academic independence of political control or interference. The battle is over, and the institution is now upheld by the intelligent loyalty of the citizens of California, without regard to party. But while the issue was uncertain, the development of special schools of applied science was scarcely practicable. Doctor Beeker and William Ashburner had given up the school of mines as a hopeless task when Christy, younger and less experienced, took it up. As he wrote me in February, 1901—

> I took an empty building without equipment, and with half a dozen students. Now I have a fully equipped department, adapted to our local needs better than any I have seen in the world. I have now nearly 250 students; and I am willing to compare the record of our graduates, now scattered all over the world, with that of any other institution of equal age.

The secret of this success lay in the enthusiasm, pertinacity, industry and personal charm of Christy himself. He was able not only to inspire his students, but to impress upon their parents and the public at large the value of the thorough training given them under his direction. His own example was contagious. Besides the practical labors of his office, he prosecuted laboratory researches of the most delicate and complicated character, in which it was a privilege for any student to be his assistant.

Before the famous Hearst building was erected and equipped for the School of Mines, Professor Christy traveled through Europe, inspecting the great laboratories and plants of technical instruction. By that time, his work had made him widely known; and I remember still with what simple-hearted surprise he expressed his gratitude for the reception he had encountered abroad.

Yet this already illustrious teacher, investigator, organizer and leader, who was delivering every year to scores of young graduates their diplomas as mining or metallurgical or chemical engineers, held no degree himself, except the primary baccalaureate in philosophy, required before he began his technical course. The reason was that in 1879, when he finished that course, the University of California was not yet granting technical degrees.

In 1902 Columbia University put an end to this anomaly by conferring upon the head of the California University School of Mines—one of the foremost rivals of its own school—the honorary degree of Doctor of Science. This graceful recognition was creditable alike to giver and recipient, and it was a great joy to Professor Christy, after his long and arduous labors in a distant field, to be thus received into the academic brotherhood. He traveled extensively at that time in the Eastern States and the Lake Superior region, studying everywhere with keen observation the methods and appliances of mining and metallurgy. In June, 1902, just after he had received his doctor's gown, he wrote me:

> We went today through the subway with Mr. Parsons and examined the part where the landslide took place. They secured the mining ground in a most original way—ran in several thousand barrels of cement grouting—and are now drilling and blasting out the cemented ground. Verily, you do wonders here in New York!

I cannot at this time present a complete catalog of Professor Christy's published works and professional activities. A man so intensely and continuously active in so many directions leaves "footprints on the sands of time" too numerous to be traced and interpreted by a hurried reporter. I know that he discussed in 1891 the practice of chlorination at the Alaska-Treadwell mine; that he was engaged for a series of years in the U. S. Circuit Court as an expert in the metallurgy of quicksilver and of lead; and that in 1900, as the result of patient and thorough experiment, he patented an improved process for the recovery of gold and silver from dilute cyanide solutions. And I know that to the *Transactions* of the American Institute of Mining Engineers (of which he became a member in 1883, and was a vice-president in 1891 and 1892) he contributed a series of highly original and important papers on the metallurgy of gold, silver and mercury, and on the training of mining engineers and the relation of American mining schools to the mining industry, as well as a remarkable biographical notice of Joseph Le Conte, his friend and colleague, which has been recognized as the most appreciative and satisfactory of the tributes paid to that illustrious and beloved leader and teacher. But beyond this list, which is enough of itself to secure for Professor Christy a permanent place in the history of American scientific and technical progress, there remains his work in connection with the California Academy of Sciences (of which he was a life member, and for five years corresponding secretary), the Society for the Promotion of Engineering Education (of which he was three years vice-president), the California Miners' Association and other bodies.

I cannot altogether forbear, though I hesitate, to speak of more sacred things—of his marriage in 1881 and the companion who is left desolate by his departure; of the anguish which they suffered in the death of a son on whom their hopes were set; of the close sympathy into which I was then drawn, by reason of my own similar bereavement, and of the unbroken loyal friendship, both before and after that event, which time did not, and death cannot, impair. I rejoice that a quick and peaceful end has crowned a fruitful life, and that the bright, strong spirit of my dear friend, "crossing the bar," went out to sea through the Golden Gate he knew and loved so well.

## German Metal Production in 1912

In 1912 there were 44 German works producing copper, lead, gold and silver, employing 9068 laborers. The production figures were as follows: Furnace-refined copper, 35,982 metric tons; electrolytic copper, 9483; cement copper, 3982; copper ore, 2574; bronze and brass, 3251; copper sulphate, 5955; soft lead, 165,865; hard lead, 10,768; work lead, 15,985 metric tons carrying 27,386 kg. of silver; silver contents of silver bars, 895,830 kg.; gold, calculated as fine gold, 43,442 kw.; doré, carrying 107,305 kg. of silver and 608 kg. of gold; residues carrying 19,368 kg. of silver, and 272 kg. of gold; lead ox-

ides, etc., 4135 metric tons; purple ore, 308,707; zinc sulphate, 6413 metric tons.

There were 31 zinc works operating, employing 13,108 aborers, producing 187,697 metric tons of rough zinc; 81,464 of refined zinc; zinc dust and zinc oxide, 22,455; lead from zinc refining, 1513 tons; cadmium, 43 metric tons.

There were also produced 10,646 metric tons of tin; 32,232 metric tons of tin-scrap and 3094 metric tons of tin ashes.

## Meeting of Chicago Section of A. I. M. E.

SPECIAL CORRESPONDENCE

The first meeting for the winter of the Chicago Section of the A. I. M. E. was held at the Chicago Engineers' Club, on the evening of Dec. 12. About 25 members were present for the dinner, and this number was increased to 30 before the close of the evening. The section was fortunate in having for its guest, in addition to Charles H. MacDowell, president of the Armour Fertilizer Works and the speaker of the evening, Bradley Stoughton, secretary of the Institute, who came to Chicago especially for the meeting.

Following the dinner, Chairman Robert W. Hunt introduced Mr. Stoughton, who responded with an interesting address in which he outlined briefly the activities of the Institute during the last year. He told something of the new sections that have been formed, mentioning particularly the Chicago, Pittsburgh and Pennsylvania Anthracite sections and describing in a general way the manner in which they hold their meetings, etc. The quantity and quality of papers that the Institute has received for publication this year have been gratifying and have far exceeded the average for years past. This has led to an unusual amount of increase in publishing and corresponding expense, and he said that it would be necessary to reduce this amount of publishing in the future or the Institute would be swamped.

He went into the matter of the various prizes, including the Hadfield prize of $1000, that are now available as awards for research work; the committees that had been appointed to coöperate with the Bureau of Mines and other Government bodies, and expressed the hope that the work of these committees would be helpful and continued. The Institute finances, he said, are in good shape, despite the fact that the receipts for several months have been seriously affected by the European war. Notwithstanding this and the increased publishing of bulletins, no increase of dues will be necessary now.

Secretary Stoughton closed his remarks by referring to the amendments that will soon be submitted to the members for their approval. There are three of these, and the most important of them is the one which, if passed, will authorize the officers to depart from the tradition of the Institute of 43 years' standing in the matter of questions of public interest. This amendment would enable the Institute to place itself on record and express itself on such questions as mining laws, etc. This matter, he said, has been ably debated on both sides, is a very important one and will likely cause some bitterness. He urged that when it comes before the members for their approval or otherwise, it be given the most serious consideration and thought, before final action is taken.

At the conclusion of Mr. Stoughton's remarks, Chairman Hunt introduced Charles H. MacDowell, who then read a paper on "The Present State of the Potash Industry," on which he is a recognized authority, and his paper on this timely subject was intensely interesting. He has spent many years in the study and investigation of the occurrence and mining of potash, especially the German deposits, but perhaps the most interesting part of his paper was that devoted to the possibilities for securing our supplies of potash from within our own borders; research and experiment work that has been done here with that object in view, and the success of the various attempts to date. The paper aroused much discussion, and Mr. MacDowell's prompt answer to all questions showed his thorough knowledge of the subject. Samples of potash salts were passed around, and geological maps of Germany, showing the location of the deposits and mines, were available.

The meeting closed with a short address by Prof. Henry W. Nichols, secretary of the Chicago Section, in which he said that plans are under way to hold a meeting in January, at which it is hoped to have Professor Moore, of the Bureau of Mines at Denver, to deliver a paper on "Carnotite." Should it be impossible to make this arrangement, a paper on "Ferromanganese," or some other timely subject, will be given.

## American Mining Congress in Phoenix

The 17th annual meeting of the American Mining Congress opened in Phœnix, Ariz., on Dec. 7. A noteworthy feature of the first day's session was a letter of greeting from President Wilson. The President's letter laid particular emphasis on the work of the Congress in promoting the interests of safety in the mining industry through its successful efforts to create the Bureau of Mines.

He urged further effort in safety work in order to reduce the number of deaths and injuries in the mining industry, still unnecessarily high. The President also called attention to the necessity of considering the conservation and proper use of the nation's mineral resources.

In the second day's session the methods of taxation of metal mines were discussed. There was a spirited debate on this question. The ad valorem or physical-valuation system was supported by R. C. Allen, of Michigan; a system of taxation, however, based on net production was indorsed by the Congress.

Protection for American copper shipments and the opening of all possible markets for the metal by the several branches of the Government were demanded in a resolution presented by Charles W. Dern, of Utah, but no action was taken on this resolution. There was a general discussion as regards the creating of public interest in mining investments.

**Production of White Arsenic in 1913** in the United States amounted to 2513 short tons, according to the U. S. Geological Survey. This was all produced by the Anaconda Copper Mining Co., the United States Smelting Co. and the American Smelting & Refining Co. About 50 tons of paris green and london purple and 4701 tons of white arsenic and arsenic sulphide were imported, making the total consumption of arsenical compounds in the United States about 7500 tons, a decrease of 2500 tons.

# Editorials

## Pulp Constants

As an important labor-saving device which promotes accuracy and aids in securing reliable mill reports, we can think of nothing that is of more importance to the wet-milling industry in general than the extensive work on "Pulp Constants," which is presented in another part of the JOURNAL. Professor Clevenger and his assistants have accomplished a noteworthy step in facilitating the work of mill operators.

In establishing the tonnage of slime-pulp charges operators have heretofore been accustomed to assume the specific gravity of the solution as 1, believing that while the actual figure was somewhat higher, it was not sufficiently so to influence the final result. We are now shown that this assumption is untrue, and that serious error in tonnage estimations may be introduced by neglecting the specific-gravity of solutions, particularly in the case of very dilute pulps. No one but the mill operator himself can truly value the importance of this information, since he has long been harassed by the difference between theoretical and actual recovery figures for which no accounting could be found. It is by no means impossible that much of the difference has been in tonnage estimation, both in the coarse-ore bins and in the pulp tanks. Professor Clevenger's work will have an important influence toward eliminating the latter.

Besides showing the sources of error, Professor Clevenger has outlined the best method of determining specific gravities of pulp and of dry slime, and has derived formulas by means of which any pulp problem may be solved. In addition to this, however, and most important to the convenience of mill operators is the fact that tables are presented whereby anyone working with any ordinary slime may determine the tonnages without any calculation whatever. The pulp weight and percentages for various specific gravities of dry slime are shown, and also the corrections for solutions of various specific gravities, all of these covering the ordinary range of milling work. For the convenience of those who desire to make their calculations by logarithms, corresponding tables are given which may be applied in ordinary routine work.

The convenience of this set of tables can hardly be overestimated. It will find an almost universal field of service in the cyanide process, particularly in those plants where a total slime is made. It will also be of great service in the practice of copper hydrometallurgy, serving to estimate tonnages of slimes in dilute or thick pulps. It will furthermore serve as a means of estimating the loss of light slimes in dam overflows or in mill-tailings discharges, a procedure which, due to the involved methods of calculation, has rarely been attempted. In fact, it is hard to say in what wet metallurgical process this article will not be helpful.

It is an unusual event for the JOURNAL to publish a 16-page article in one issue, but the advantage of having it all together and in such form as to be of maximum service to the operator, has led to departure from the usual procedure. It is to be hoped that all of those interested in wet milling processes will appreciate the efforts of the author to bring long calculations into such form that they may be used without trouble or effort.

Professor Clevenger is to be congratulated upon the successful result of his endeavor to systematize these tonnage estimations. The JOURNAL is glad now, as always, to present a feature of unusual interest and of great value to operators.

## The Hill Iron-Ore Lands

The final surrender of the Hill leases on the northern Mesabi by the United States Steel Corporation at the close of 1914 ends a period of eight years during which the Corporation's subsidiary, the Great Western Ore Co., has spent over $6,000,000 for development work and has mined approximately 27,000,000 tons of ore. At the time the lease was made, in 1906, the terms were considered rather onerous, and the opinion was freely expressed that the lease was made less for any profit there might be in it than to forestall the possibility of the absorption of these lands by a competing combination. This opinion was confirmed by the fact that notice of the surrender of the lease was suspiciously coincident with the beginning of the suit for the dissolution of the Corporation under the Sherman law.

The terms of the lease compelled the Steel Corporation to spend a large amount in development at once, in order to avoid the payment, without equivalent, of heavy minimum royalties. This was done and the result was the opening of eight large mines, which have been heavy shippers. The lease fell below its minimum for several years, as was inevitable, but gradually caught up until at the opening of the present year it was only about 440,000 tons behind. The minimum provided in the lease was 750,000 tons for 1907, the first year, and increased by 750,000 tons each year, so that the maximum for 1914 was 6,000,000 tons. The figures for the year have not been made up, but it is believed that the total ore taken out has been close to 6,500,000 tons, so that the lessee will come out even. To do this the Corporation mines on the southern and western Mesabi have been rather neglected and will make but a poor showing for the season. Next season, of course, their production will have to be increased.

According to the estimate of the Minnesota Tax Commission the Hill ore lands contain a little over 400,000,000 tons of iron-ore reserves, which can be increased by some deposits which may be made available by washing and concentration. The Great Northern Iron Ore trustees, in whom the titles are vested, have announced that arrangements have been made by lease or otherwise to continue the workings of the mines already opened. It is hardly likely that they will be pushed to their full capacity as they have been for the past two or three years; but allowing for less intensive working, this means that

somewhere between four and five million tons will be added to the supply of merchant ore which is offered for sale to furnaces. This is more than the market will stand unless there be a large increase in demand. The Steel Corporation has abundant reserves for its own needs, and it may be some years before outside interests can take up the surplus which can be offered by the mines on the Hill lands.

## An Arizona Decision Respecting Mining Rights-of-Way

The appeal of the Inspiration Consolidated Copper Co. vs. the New Keystone Copper Co. to the Supreme Court of Arizona was lately decided in favor of the New Keystone company. The property of this company separates the Inspiration and Live Oak branches of the Inspiration company. It was alleged by the Inspiration company, "That for the successful working of the Live Oak group of mines it is necessary and indispensable to have a right-of-way through one of the Keystone mines for the construction, maintenance and operation of a drift 9 ft. high and 11 ft. wide." The Keystone company having refused permission for this, the Inspiration started to drive it anyway, whereupon the Keystone obtained an injunction and a favorable verdict in the lower court, from which the Inspiration appealed to the Supreme Court.

We have previously referred to this case. The Supreme Court of Arizona has now decided against the Inspiration on the ground that the purpose for which the right-of-way is sought is clearly for a private use and not a public use, and therefore an act of taking for the purposes alleged would clearly be an unconstitutional exercise of the right of eminent domain. The removal of all doubts upon this point by the Supreme Court of Arizona is an important thing in connection with the mining industry of that state. As between the Inspiration and New Keystone companies, the natural result was the renewal of overtures by the Inspiration to purchase the New Keystone property, and an arrangement has been made whereby Inspiration will absorb Keystone, giving one share for nine.

## California Redwood

California redwood is a remarkable material. It is a wood that is obtainable in large boards, is straight-grained, free from knots, is easily worked, being soft, and yet it is tough and durable. For the manufacture of tanks, rectangular and round, it is the ideal wood, and it has been extensively used for them in the cyanide process and in ore-concentrating mills. Lately it has been finding wide employment also in copper-extraction plants.

Apropos of the last use, Lawrence Addicks, who is certainly an authority, recently made an interesting remark in a technical meeting. Mr. Addicks lately changed from running a great copper refinery near New York to the direction of a copper-extraction plant at Douglas, Ariz. He said:

> There are two questions I want to ask. One is regarding the apparently remarkable wood in the West, which seems to withstand the acid liquors. I am used in all my experiences in electrolytic work in the East to see wood, after an exposure to sulphuric acid, reduced to a soft charcoal through which you can poke your finger. If redwood will withstand acid to the extent which my brief observation indicates, I do not see that there is any problem entailing the use of asphalt mixtures and other protective coatings for this work.

Other observers have been equally amazed when beholding the unlined redwood tanks at Butte, Mont., and elsewhere filled with acid liquor and apparently unaffected after prolonged use. It would be interesting to have a scientific explanation of the undoubted resistivity of redwood in this respect.

## German-Owned Belgian Works

It has perhaps heretofore escaped general attention that some of the important metallurgical works of Belgium were owned and operated by Germans previous to the war. Thus, the zinc smelteries at Overpelt and Lommel are concerns of Beer, Sondheimer & Co., who are also heavily interested in Engis and Prayon, while the great silver-lead refinery of the Usine de Desargentation Soc., Hoboken-lez-Anvers, is a plant in which the Metallgeschaft and the Deutsche Gold- und Silber-Scheideanstalt are heavily interested. It is a fair assumption that special pains have been taken to keep these works out of harm's way. The refinery at Antwerp was uninjured during the bombardment and remained in operation up to Oct. 6. It then became idle, but German papers of the latter part of October reported that it would be put in operation again as soon as possible. According to recent reports zinc smelting is going on right along at Lommel and Overpelt, and but little damage is said to have been done to the works on the Meuse.

## Anaconda Resumes Construction

It is reported that the Anaconda company will resume its plans for the reconstruction of its electrolytic refinery at Great Falls. The new plant will have a capacity of turning out 120,000,000 lb. of refined copper per annum. In some respects Great Falls is very well situated as a copper-refining point; in other respects it is not quite so well off. It enjoys uncommonly cheap hydroelectric power, and geographically a western refinery naturally commands the copper consumption of the Middle West. A New York refiner supplying a manufacturer in Detroit, for example, has to pay freight on copper from Montana to New York, let us say, and then back to Detroit, while the Western refiner can supply Detroit without paying any back freight. Such conditions permit copper refined in the West to come as far east as Rome, N. Y., in certain circumstances.

Respecting the copper situation in Germany, a newspaper dispatch of last week reported that the scarcity had become so acute that domestic pans and kettles were being requisitioned for brass-making for cartridges; which is probably nonsense. However, with copper worth more than 20c. per lb., old copper kettles are a realizable asset and the junkmen of Germany are doubtless doing a good business. Another cable dispatch in the same paper said that the reason why the British are so slow in searching detained ships is that copper is being concealed *in* and *under* bales of cotton. About the *in* we guess it is nonsense. As to the *under* that is probably a fact. It is customary in loading mixed cargoes to put pigs of metal at the bottom. We never heard of stevedores loading metal on top of cotton.

## BY THE WAY

The American Smelting & Refining Co. has leased quarters in the new Equitable Building, now nearing completion, at 120 Broadway. The lease covers a period of 10 years, at an aggregate rental of approximately $1,250,000. The company will occupy the entire 34th and half of the 35th floor in the new building, which has been erected on the site of the old Equitable Building, destroyed by fire several years ago. The Smelting Company, until the completion of the new building, which is expected to be ready by Mar. 1, 1915, will occupy its present quarters in the City Investing Building, at 165 Broadway.

Apparatus described as a device for locating mineral deposits thousands of feet underground, which was established by men believed to be German engineers at Alamo, Lower California, is shown now to be a radio station equipped to operate over a radius of 2000 miles, says the N. Y. *Evening Post.* The plant was seized by Mexican authorities, according to a letter received at San Francisco on Nov. 14. Alamo is a mining town, 60 miles back in the mountains from Ensenada, at an altitude of about 4000 ft. The station is said to have been erected by three Germans, supposed to have been landed somewhere along the coast from the German cruiser Nurnberg.

The Arizona mining companies are not exhibiting any great alarm over the 80% law, meaning that 80% of their employees must be American citizens, which was adopted by the state at the last election. If the law goes into effect, its constitutionality will promptly be tested, and means will be found to carry the case, if necessary, to the U. S. Supreme Court without any delay. Such action has not yet been in order, for the reason that the diplomatic representatives of Great Britain and Italy have protested against the proposed law to the Department of State, and upon the representations of the Secretary of State, the Governor of Arizona has withheld the promulgation of the law, wherefore conditions in Arizona are still in *statu quo,* in so far as the employment of labor is concerned. However, the Governor of Arizona has indicated that he has no right to defeat the will of the people and will not try to do so.

Here is how Brother Wilson, who is at the head of the Department of Labor, hands one to James MacNaughton in his annual report:

> If the owners of the mine properties in the Calumet copper region and the Colorado coal fields had been on the ground at the inception of the strikes, and personally in charge, there is reason to believe that no strikes would have occurred. If the managers of the property involved in the Michigan strike had dealt with the dispute at its inception, as its principal owners (Messrs. Shaw and Agassiz) might have done had they been on the ground and personally in charge, there is reason to believe that no strike would have occurred. But the local superintendent, doubtless an excellent property manager, appears by the reports to have been a poor manager of men. Whatever may have been the responsibility of the workmen for the strike and its incidents, the local management cannot be wholly acquitted; and upon the elementary principle of agency, as sound in morals as in law, ultimate responsibility must rest upon the owners.

We do not think that Mr. Shaw and Mr. Agassiz, who have always been sincere and earnest in their attention to company affairs, would relish this any more than Mr. MacNaughton if it came from a serious source, but coming from the U. S. Department of Labor all three will doubtless regard it as a joke; but for our own part we think it is a shame that such things should be inscribed in official records.

## Effect of the War on Chemical Laboratories

The following excerpts from *Metal Industry,* December, 1914, while written about English conditions, find application in the United States:

"One of the businesses badly hit by the war is that of analytical chemistry. Most of the glass and porcelain apparatus used in chemistry is made in Germany and Austria. Bohemian glass, Royal Berlin porcelain, Dresden porcelain and Jena glass are names known to chemists all over the world. It must not be thought that the apparatus is cheap, and that this is the cause of foreigners having the market; the sole reason they have obtained the trade is that they have studied the scientific manufacture of the articles and with the aid of well equipped laboratories have obtained the best results. The price of these goods went up 50% immediately war was declared, and as the stocks in this country are being rapidly depleted, further advances are to be looked for. Some apparatus is already unobtainable.

"Filter papers are another line of which the price has advanced 50%, and the German stock in England is running out. These are also largely obtained from Sweden but the prices have also gone up 50%. Some filter papers are made in England, but the climate is not cold enough to make the high-class chemical filter papers and, consequently, they will always have to be obtained from colder countries. Intense cold for weeks at a time is necessary to obtain good quality filter papers. The pure chemicals used in analysis are largely obtained from Germany, but the supply being cut off and stocks giving out, prices are advancing from 50 to 600%. Unfortunately, these goods cannot be made quickly, even if the works and material are on the spot. We understand that it takes two years from the time the clay of which the Royal Berlin porcelain is made is mined, until it becomes the finished article known to laboratories. Not only for their own benefit, but for the benefit of the trades of the nation, chemists should economize in glass and porcelain apparatus as much as possible. If the war lasts six months longer, as, unfortunately, there is every possibility of it doing, some laboratories will probably have to close down for lack of apparatus."

In commenting on the above to the JOURNAL, one of the leading American chemists remarked that Royal Berlin porcelain was unobtainable in New York, but that the more expensive fused silica was a partial substitute. For Jena glass, he was finding some of the American glasses a fair substitute. Filter papers were list plus 50%. Although small shipments of chemicals and supplies were coming through Holland, the general market is greatly upset. Certain of the more uncommon chemicals are absolutely unobtainable, and American chemists should be as economical as possible in their use of both chemicals and apparatus.

## PERSONALS

Dr. L. D. Ricketts is expected in New York to spend the holidays.

L. Selmi has become chief chemist for the Otis Steel Co., Cleveland, Ohio.

Fred F. Hunt has removed his office and laboratory to 10 & 12 Old Slip, New York.

Dwight E. Woodbridge, Duluth, Minn., recently spent several days in Chicago and several in New York.

A. L. Flagg, of Kelvin, Ariz., manager of the Kelvin-Sultana Copper Co., is in the East for a brief vacation.

H. V. Snell, lessee of the Warrior Copper Co., Globe, Ariz., passed through Chicago recently on his way west.

N. O. Lawton, Lawton, Mich., will be at Hurley, Wis., until Jan. 1, for the Montreal Mining Co., on special work.

C. B. Lakenan, general manager of Nevada Consolidated, is visiting in the East and will spend a little while in New York.

H. W. Hardinge has gone to Arizona for a three weeks' tour of the mining camps and to attend the American Mining Congress.

The Perkin medal to be presented in January, 1915, has been awarded to Dr. Edward Weston, of Waverley, N. J., for his work in metallurgy.

R. N. Copeland, mine superintendent of the Cia. Estanifera de Llallagua, arrived in New York last week from Bolivia, for a visit to the United States.

Samuel Hale, manager of the Algoma Steel Corporation, Sault Ste. Marie, Ont., is retiring owing to ill-health. J. Frater Taylor, the president, will take charge of the operation of the plant.

J. Parke Channing, of New York, was in Houghton, Mich., recently, consulting with Sidney W. Lang, engineer in charge of the Naumkeag exploration operations relative to the progress of the work.

C. W. Shepard has been appointed general superintendent of North works, Illinois Steel Co., succeeding William H. Pratt, deceased. He had been assistant superintendent up to the time of Mr. Pratt's death.

George Safford, of London, who founded, and has edited the successive editions of "Who's Who in Mining and Metallurgy" is now preparing the 1915 edition of the book, and requests engineers to send in their records without delay.

J. P. Bickell, of Toronto, Ont., has returned from a prospecting trip of several months in northern Alberta and British Columbia. He located a placer gold deposit on a tributary of the Findlay River above the headwaters of Peace River.

Bradley Stoughton, secretary of the American Institute of Mining Engineers, was in Chicago on Dec. 12, to attend the meeting of the Chicago Section. While in the West, Mr. Stoughton called on the Student Section at Madison, Wisconsin.

Heinrich J. Freyn resigned as third vice-president of H. Koppers Co., Chicago, Dec. 1. Mr. Freyn, who is a member of the American Iron & Steel Institute, the American Society of Mechanical Engineers and the American Institute of Mining Engineers, and resides at 5201 Harper Ave., Chicago, has not yet announced his plans for the future.

Professors Malcolm and Ellis, of the Queen's School of Mining, Kingston, Ont., have been given leave of absence to go to the front with the Fifth Canadian Engineering Corps. Prof. E. A. Stone, of Vancouver, has been appointed acting professor of Municipal and Structural Engineering in place of Professor Malcolm, and J. B. Harvey, late of McGill University, acting professor of General Engineering and Surveying, to take the place of Professor Ellis. J. E. Hyde, assistant professor of Geology, has resigned to accept a position in the Western University.

## OBITUARY

William Henry White, of White & Brother, Inc., Philadelphia, died in that city, Dec. 14.

Charles J. Canda, vice-president of the Chrome Steel Works, died at Summit, N. J., Nov. 29, aged 76 years. He was prominent in business and politics and served for several years as assistant treasurer of the United States at New York.

Captain Richard Trevarthan, a type of the Cornish miner who did more to develop the Michigan copper district than any other set of men, died at Houghton, Mich., Dec. 10. For 22 years he was mining captain in charge of all underground work at the old Atlantic mine, then under Stanton management, now a part of the Copper Range Consolidated. He came to America in 1872 and entered the employ of Calumet & Hecla in 1874; went to Atlantic 34 years ago and became captain two years later. When the Champion mine was opened he was in charge of the work, continuing there as head mining captain for six years. Then he went to Ojibway and opened that mine, retiring when that property closed down. He has a son, Richard S. Trevarthan, clerk at the Mohawk mine.

Joseph Block, founder of the firm of Block & Pollak and the Cincinnati Forge & Iron Works, which later were merged into the Block-Pollak Iron Co., Chicago, died Dec. 6, aged 83 years. He was born in Phaffenhofen, France, and came to this country at the age of 7. The firm of Block & Pollak was organized in the early sixties. Mr. Block had great confidence in the industrial possibilities of Chicago, and in 1893 joined in the organization of the Inland Steel Co., which began as a small operation at Chicago Heights. He continued as a director in that company from its inception, and he was in no small measure responsible for the establishment of its Indiana Harbor works. He was also a director of the Buffalo Steel Co., Tonawanda, N. Y. Mr. Block was a member of the Standard Club and the Lake Shore Country Club. He leaves three sons, all of whom are active in the organization of the Inland Steel Co., and four daughters.

News has been received of the death of William H. MacGarvey, oil operator, at Vienna, Austria, at the age of 71 years. He was born at Huntington, Que., and at an early age removed to Petrolea, Ont., where he speedily acquired wealth in connection with the oil discoveries. He was the first mayor of Petrolea, and held that office for many years. In 1876 he was employed by the Canadian government to locate coal deposits in the west and was successful in making discoveries in the Estevan district, Saskatchewan. The last 25 years of his life were spent in Europe, where he controlled large oil interests in Galicia. Mr. McGarvey received decorations from the Austrian Emperor for introducing Canadian oil-drilling methods into that country, and was called upon to advise the British Admiralty when the naval board had under consideration the use of oil for naval purposes. He sustained enormous losses during the present war, the town of Mrianpol, which he founded and where he had 2000 employees, having been destroyed in the course of recent fighting.

## SOCIETIES

**University of Minnesota**—The corner stone of the new School of Mines Building was laid Saturday, Nov. 28, in the presence of the Board of Regents of the University, the faculty of the School of Mines, students and friends. Dean W. R. Appleby and President G. E. Vincent officiated.

**Engineers' Society of Pennsylvania**—The following candidates have been nominated for office during the year 1915: President, Farley Gannett, Harrisburg; first vice-president, Charles H. Mercer, Harrisburg; second vice-president, J. Murray Africa, Huntingdon; secretary, Edward R. Dasher, Harrisburg; treasurer, R. Boone Abbott, Harrisburg; resident directors, Thomas Earle, C. A. Emerson, Jr., F. Harbert Snow, Harrisburg.

**Colorado School of Mines**—This school at Golden, has announced its intention of giving a short course for practical prospectors, covering about three weeks, some time during the coming spring. The course will include the elements of chemistry, blowpipe analysis, mineralogy and geology, the object being to give men without technical education a better working knowledge of those subjects that will aid them in finding or identifying minerals in the field. The course will be free to all residents of Colorado.

**International Engineering Congress**—A circular from the Committee of Management says that some confusion seems to have arisen in the minds of at least certain of the engineers of this country, between the International Electrical Congress, which it was proposed to hold in San Francisco in September, 1915, and the International Engineering Congress, which is to be held during the same month. Owing to the unfortunate situation existing abroad, and the impossibility of convening the International Electrotechnical Commission, under whose authorization the Electrical Congress was to have been held, it has been decided by the governing body of the American Institute of Electrical Engineers to postpone indefinitely the holding of the Electrical Congress. This does not affect the

International Engineering Congress, which goes ahead as originally planned. Marked progress is being made in connection with the latter, and papers have already been received from several of the foreign countries, and everything points to a successful issue.

**American Institute of Mining Engineers**—The fourth annual meeting and banquet of the Columbia Section was held Nov. 20, at the Spokane Hotel, with 40 members in attendance. Prof. Francis A. Thomson, of Pullman, head of the department of mines at Washington State College, retiring president, was toastmaster, and L. K. Armstrong, secretary-treasurer, was master of ceremonies. The principal address was made by Prof. F. M. Handy, of Pullman, associate professor of geology at the college, on the "Economic Geology of Eastern Washington." Other speakers were Loren A. Campbell, of Rossland, B. C.; Oscar Lachmund, Greenwood, B. C.; Frederic Keffer, Greenwood, B. C.; G. H. Wyman, Jr., Wallace, Idaho; Sam H. Richardson, mining engineer, Republic, and Prof. D. C. Livingston, Moscow, head of the mining department at the University of Idaho. The report of the secretary-treasurer for the year showed that the membership had increased from 120 to 150, and that the section was in good financial condition. F. A. Ross, of Spokane, was elected president; Rush J. White, of Wallace, Idaho, vice-president; L. K. Armstrong, of Spokane, secretary-treasurer. Mr. Armstrong has been secretary-treasurer of the section since it was organized four years ago.

## INDUSTRIAL NEWS

The Pacific Tank & Pipe Co. will open an office on Jan. 1, 1915, in the Lewis Building, 275 Oak St., Portland, Ore.

Sullivan Machinery Co., Chicago, Ill., reports the following sale to the Vindicator Consolidated Gold Mining Co.: One Sullivan class "WN-2" direct-connected motor-driven unit compressor, size 26x14½x18 in. This machine has a piston displacement of 1984 cu.ft. at 10,000 ft. altitude.

F. L. Bunton, formerly manager of the Chicago office of the Heine Boiler Co., has severed his connection with that company to become manager of the Chicago office of The Goulds Manufacturing Co., 3801-3811 South Ashland Ave., Chicago, Ill., manufacturers of pumps and hydraulic machinery.

The main floor of the power house of the new smeltery of the Arizona Copper Co. consists of Berger Multiplex steel plate laid on structural steel I-beams and covered with concrete, the concrete being reinforced with ½-in. and ¼-in. rods. Berger Multiplex plates were also used in the construction of the roof. In this case they were wired to the purlins with No. 10 wire. The concrete was then filled in and troweled smooth, and when dried out was waterproofed with a composition of tar, cement and coal oil, followed by a coating of hot naphtha into which was embedded a layer of 3-ply roofing paper.

## TRADE CATALOGS

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Catalog. Magnetic Switches. 16 pp., illus., 5x8 inches.

Williams Bros., Ithaca, N. Y. Circular. Well Drilling Machinery & Tools. 12 pp., illus., 10½x8 inches.

The Hitchcock Mfg. Co., Tarentum, Penn. Catalog. Turnouts, Switches and Frogs. 38 pp., illus., 6x9 inches.

The Cleveland Rock Drill Co., Cleveland, Ohio. Bull. No. 33, Cleveland Hand Rotated Hammer Drills. 8 pp. illus. 9x6 inches.

P. H. & F. M. Roots Co., Connersville, Ind. Catalog 42, Roots Blowers, 47 pp., illus., 7½x10 in. This catalog describes the Root line of blowers for smelting furnaces; contains charts and data, also views of the installations at the plants of the British Columbia Copper Co., Anaconda Copper Mining Co., United Verde Copper Co., and the U. S. Smelting Co. Catalog 46, Foundry Blowers, 47 pp., illus., 7½x10 in. Some blowers shown in this catalog may be used for mine ventilation, and are capable of operating against pressures varying from ½ lb. to 10 lb. per sq.in., but the company builds blowers of any desired capacity, some of the largest having a displacement of 400 cu.ft. per revolution. The machines shown are of the positive pressure type. Catalog 48, Vacuum Pumps, 16 pp., illus., 6x9 in. These pumps have recently been found to be of use in connection with filtration in cyanide plants. Catalog 47, General Catalog, 16 pp., illus., 6x9 in. In a condensed manner gives the full line of blowers, pumps and exhausters made by the Roots company.

## NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

DRILL Pneumatic Tool. John F. Clement, Philadelphia, Penn., assignor, by mesne assignments, to The Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 13,826, reissue; Nov. 17, 1914.)

DRILL—Rock Drill. Michael Smith, Bisbee, Ariz. (U. S. No. 1,116,146; Nov. 3, 1914.)

DRILL—Rock Drill Bit. Moses Arthur Knapp, Oakland, Calif. (U. S. No. 1,118,292; Nov. 24, 1914.)

DRILL EXTRACTOR. Edward Wilson and William A. McLeod, Bisbee, Ariz. (U. S. No. 1,117,468; Nov. 17, 1914.)

DRILL PULLER. Howison Crouch, Grass Valley, Calif. (U. S. No. 1,117,554; Nov. 17,1914.)

DRILLING—Core-Drilling and Hoisting Machine. Paul J. Diemunsch and Thomas H. Dobbins, New York, N. Y., and Edmund Dalgleish, Cleveland, Ohio; said Dalgleish assignor to said Diemunsch and Dobbins. (U. S. No. 1,117,806; Nov. 17, 1914.)

DRILLS—Improvements in Feeding Means of Percussive Rock Drills, Coal Cutters and the Like. F. Simon and J. W. Scott, Minnaar, Transvaal. (Brit. No. 16,144 of 1913.)

ELECTRIC FURNACE. Walter N. Crafts, Oberlin, Ohio. (U. S. No. 1,114,733; Oct. 27, 1914.)

EXTRACTION BY ELECTROLYSIS—Process of Separating Metals from Ores. Herman A. Wagner, East Orange, N. J. (U. S. No. 1,115,351; Oct. 27, 1914.)

FERROPHOSPHORUS—Manufacture of Ferrophosphorus. David I. Miller, Birmingham, Ala. (U. S. No. 1,115,471; Oct. 27, 1914.)

FILTERING MEDIUM. James Edward Porter, Syracuse, N. Y., assignor to General Filtration Co., Rochester, N. Y. (U. S. No. 1,117,601; Nov. 17, 1914; and 1,118,441; Nov. 24, 1914.)

FINK PROCESS—Process of Reducing Metals. Colin G. Fink, Schenectady, N. Y., assignor to General Electric Co. (U. S. No. 1.119,588; Dec. 1, 1914.)

FLOTATION PROCESS—Method of Concentrating Ores. William Sydney Stevens, Magdalena, N. M., assignor, by mesne assignments, to The Ozark Smelting & Mining Co., Cleveland, Ohio. (U. S. No. 1,116,642; Nov. 10, 1914.)

FUME HOOD for Chemical Laboratories. Silas E. Coleman, Oakland, Calif. (U. S. No. 1,117,551; Nov. 17, 1914.)

GRIZZLY. Edmund W. Paget, Portland, and Nathan L. Raber, Corvallis, Ore. (U. S. No. 1,117,897; Nov. 17, 1914.)

KELP REDUCTION. Harry Wilson, San Francisco, Calif., assignor to Pacific Kelp Co., San Francisco, Calif. (U. S. No. 1,116,965; Nov. 10, 1914.)

LAMP—Mine Safety Lamp. Fritz Fäber, Dortmund, Germany. (U. S. No. 1,116,048; Nov. 3, 1914.)

LEACHING—Process of Extracting Copper from Ores. George D. Van Arsdale, East Orange, N. J. (U. S. Nos. 1,119,477 and 1,119,478; Dec. 1, 1914.)

MANGANESE STEEL—Manufacture of Manganese Steel from Scrap. Henry M. Howe, Bedford Station, N. Y., assignor to Taylor-Wharton Iron & Steel Co., High Bridge, N. J. (U. S. No. 1,117,384; Nov. 17, 1914.)

METALLURGICAL FURNACE. Herbert Davison and Leonard Charles Harvey, Battersea, London, England, assignors to The Morgan Crucible Co., Ltd., London, England. (U. S. No. 1,118,534; Nov. 24, 1914.)

MINE AMBULANCE. Cornelius P. Moran, Tunnelhill, Penn. (U. S. No. 1,115,560; Nov. 3, 1914.)

MINE-CAR-DOOR LATCH-PLATE. James R. Fleming, Scranton, Penn. (U. S. No. 1,116,258; Nov. 3, 1914.)

MINE CARS—Means for Holding Cars on Mine Cages. Clarence W. Parsons, St. Louis, Mo. (U. S. No. 1,118,510; Nov. 24, 1914.)

MINING-CAR WHEEL. Alfred Bryant Day, Knoxville, Tenn. (U. S. No. 1,117,344; Nov. 17, 1914.)

MIXING APPARATUS. Utley Wedge, Ardmore, Penn. (U. S. No. 1,116,182; Nov. 3, 1914.)

MOLYBDENUM—Process for Recovering Molybdenum from Its Ores and Concentrates. Frederick D. S. Robertson, Toronto, Ont. Canada, assignor of three-fourths to Michael J. O'Brien, Renfrew, Ont., Canada. (U. S. No. 1,118,150; Nov. 24, 1914.)

NODULIZING—Process and Apparatus for Removing Adherent Material from Nodulizing Kilns. Francis Bird Dutton, Lebanon, Penn., assignor to the Pennsylvania Steel Co., Lebanon, Penn. (U. S. No. 1,117,814; Nov. 17, 1914.)

ORE DRESSING—Improvements in a Process of Dressing Ores by Means of Gas. K. Takeda, Tokyo, Japan. (Brit. No. 20,158 of 1913.)

ORE TREATMENT—Process for Treating Ores. William A. Thacher, Lake City, Colo., assignor to the Acid Process Co. (U. S. No. 1,119,473; Dec. 1, 1914.)

PNEUMATIC HAMMER. Lewis E. Summers, Detroit, Mich., assignor to Chicago Pneumatic Tool Co., Chicago, Ill. (U. S. No. 1,115,985; Nov. 3, 1914.)

QUICKSILVER—Process for Extraction of Mercury from Its Ores and other Materials. Edwin Bryant Thornhill, Gray Summit, Mo. (U. S. No. 1,119,377; Dec. 1, 1914.)

RABBLE ARM—Air-Cooled Rabble Arm. Charles C. Fisher and Hubert H. Rountrey, South Norfolk, Va. (U. S. No. 1,116,255; Nov. 3, 1914.)

RARE EARTHS—Method of Separating the Rare Earths, together with Thorium, Cerium, and Zirconium, by Electrolysis. Louis M. Dennis, Ithaca, N. Y. (U. S. No. 1,115,513; Nov. 3, 1914.)

# Editorial Correspondence

### SAN FRANCISCO—Dec. 9

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The principal mines involved are the Alto, with a good record of production; the Salero, a wide vein of promise; the Royal Blue, which has shipped many cars of good ore; the Bland, thought to be a good mine; the Viceroy, also a shipper; the Montezuma, which has sent out bonanza ore, $300 a ton or better; the Empress of India, Eureka, Victor, Burro and

International Engineering Congress, which goes ahead as originally planned. Marked progress is being made in connection with the latter, and papers have already been received from several of the foreign countries, and everything points to a successful issue.

**American Institute of Mining Engineers**—The fourth annual meeting and banquet of the Columbia Section was held Nov. 20, at the Spokane Hotel, with 40 members in attendance. Prof. Francis A. Thomson, of Pullman, head of the department of mines at Washington State College, retiring president, was toastmaster, and L. K. Armstrong, secretary-treasurer, was master of ceremonies. The principal address was made by Prof. F. M. Handy, of Pullman, associate professor of geology at the college, on the "Economic Geology of Eastern Washington." Other speakers were Loren A. Campbell, of Rossland, B. C.; Oscar Lachmund, Greenwood, B. C.; Frederic Keffer, Greenwood, B. C.; G. H. Wyman, Jr., Wallace, Idaho; Sam H. Richardson, mining engineer, Republic, and Prof. D. C. Livingston, Moscow, head of the mining department at the University of Idaho. The report of the secretary-treasurer for the year showed that the membership had increased from 120 to 150, and that the section was in good financial condition. F. A. Ross, of Spokane, was elected president; Rush J. White, of Wallace, Idaho, vice-president; L. K. Armstrong, of Spokane, secretary-treasurer. Mr. Armstrong has been secretary-treasurer of the section since it was organized four years ago.

## INDUSTRIAL NEWS

The Pacific Tank & Pipe Co. will open an office on Jan. 1, 1915, in the Lewis Building, 275 Oak St., Portland, Ore.

Sullivan Machinery Co., Chicago, Ill., reports the following sale to the Vindicator Consolidated Gold Mining Co.: One Sullivan class "WN-2" direct-connected motor-driven unit compressor, size 26x14½x18 in. This machine has a piston displacement of 1984 cu.ft. at 10,000 ft. altitude.

F. L. Bunton, formerly manager of the Chicago office of the Heine Boiler Co., has severed his connection with that company to become manager of the Chicago office of The Goulds Manufacturing Co., 3801-3811 South Ashland Ave., Chicago, Ill., manufacturers of pumps and hydraulic machinery.

The main floor of the power house of the new smeltery of the Arizona Copper Co. consists of Berger Multiplex steel plate laid on structural steel I-beams and covered with concrete, the concrete being reinforced with ½-in. and ¼-in. rods. Berger Multiplex plates were also used in the construction of the roof. In this case they were wired to the purlins with No. 10 wire. The concrete was then filled in and troweled smooth, and when dried out was waterproofed with a composition of tar, cement and coal oil, followed by a coating of hot naphtha into which was embedded a layer of 3-ply roofing paper.

## TRADE CATALOGS

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Catalog. Magnetic Switches. 16 pp., illus., 5x8 inches.

Williams Bros., Ithaca, N. Y. Circular. Well Drilling Machinery & Tools. 12 pp., illus., 10½x8 inches.

The Hitchcock Mfg. Co., Tarentum, Penn. Catalog. Turnouts, Switches and Frogs. 38 pp., illus., 6x9 inches.

The Cleveland Rock Drill Co., Cleveland, Ohio. Bull. No. 33, Cleveland Hand Rotated Hammer Drills. 8 pp. illus. 9x6 inches.

P. H. & F. M. Roots Co., Connersville, Ind. Catalog 42, Roots Blowers, 47 pp., illus., 7½x10 in. This catalog describes the Root line of blowers for smelting furnaces; contains charts and data, also views of the installations at the plants of the British Columbia Copper Co., Anaconda Copper Mining Co., United Verde Copper Co., and the U. S. Smelting Co. Catalog 46, Foundry Blowers, 47 pp., illus., 7½x10 in. Some blowers shown in this catalog may be used for mine ventilation, and are capable of operating against pressures varying from ½ lb. to 10 lb. per sq.in., but the company builds blowers of any desired capacity, some of the largest having a displacement of 400 cu.ft. per revolution. The machines shown are of the positive pressure type. Catalog 48, Vacuum Pumps, 16 pp., illus., 6x9 in. These pumps have recently been found to be of use in connection with filtration in cyanide plants. Catalog 47, General Catalog, 16 pp., illus., 6x9 in. In a condensed manner gives the full line of blowers, pumps and exhausters made by the Roots company.

## NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

DRILL Pneumatic Tool. John F. Clement, Philadelphia, Penn., assignor, by mesne assignments, to The Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 13,826, reissue; Nov. 17, 1914.)

DRILL—Rock Drill. Michael Smith, Bisbee, Ariz. (U. S. No. 1,116,146; Nov. 3, 1914.)

DRILL—Rock Drill Bit. Moses Arthur Knapp, Oakland, Calif. (U. S. No. 1,118,292; Nov. 24, 1914.)

DRILL EXTRACTOR. Edward Wilson and William A. McLeod, Bisbee, Ariz. (U. S. No. 1,117,468; Nov. 17, 1914.)

DRILL PULLER. Howison Crouch, Grass Valley, Calif. (U. S. No. 1,117,554; Nov. 17,1914.)

DRILLING—Core-Drilling and Hoisting Machine. Paul J. Diemunsch and Thomas H. Dobbins, New York, N. Y., and Edmund Dalgleish, Cleveland, Ohio; said Dalgleish assignor to said Diemunsch and Dobbins. (U. S. No. 1,117,806; Nov. 17, 1914.)

DRILLS—Improvements in Feeding Means of Percussive Rock Drills, Coal Cutters and the Like. F. Simon and J. W. Scott, Minnaar, Transvaal. (Brit. No. 16,144 of 1913.)

ELECTRIC FURNACE. Walter N. Crafts, Oberlin, Ohio. (U. S. No. 1,114,733; Oct. 27, 1914.)

EXTRACTION BY ELECTROLYSIS—Process of Separating Metals from Ores. Herman A. Wagner, East Orange, N. J. (U. S. No. 1,115,351; Oct. 27, 1914.)

FERROPHOSPHORUS—Manufacture of Ferrophosphorus. David I. Miller, Birmingham, Ala. (U. S. No. 1,115,471; Oct. 27, 1914.)

FILTERING MEDIUM. James Edward Porter, Syracuse, N. Y., assignor to General Filtration Co., Rochester, N. Y. (U. S. No. 1,117,601; Nov. 17, 1914; and 1,118,441; Nov. 24, 1914.)

FINK PROCESS—Process of Reducing Metals. Colin G. Fink, Schenectady, N. Y., assignor to General Electric Co. (U. S. No. 1.119,588; Dec. 1, 1914.)

FLOTATION PROCESS—Method of Concentrating Ores. William Sydney Stevens, Magdalena, N. M., assignor, by mesne assignments, to The Ozark Smelting & Mining Co., Cleveland, Ohio. (U. S. No. 1,116,642; Nov. 10, 1914.)

FUME HOOD for Chemical Laboratories. Silas E. Coleman, Oakland, Calif. (U. S. No. 1,117,551; Nov. 17, 1914.)

GRIZZLY. Edmund W. Paget, Portland, and Nathan L. Raber, Corvallis, Ore. (U. S. No. 1,117,897; Nov. 17, 1914.)

KELP REDUCTION. Harry Wilson, San Francisco, Calif., assignor to Pacific Kelp Co., San Francisco, Calif. (U. S. No. 1,116,965; Nov. 10, 1914.)

LAMP—Mine Safety Lamp. Fritz Fäber, Dortmund, Germany. (U. S. No. 1,116,048; Nov. 3, 1914.)

LEACHING—Process of Extracting Copper from Ores. George D. Van Arsdale, East Orange, N. J. (U. S. Nos. 1,119,477 and 1,119,478; Dec. 1, 1914.)

MANGANESE STEEL—Manufacture of Manganese Steel from Scrap. Henry M. Howe, Bedford Station, N. Y., assignor to Taylor-Wharton Iron & Steel Co., High Bridge, N. J. (U. S. No. 1,117,384; Nov. 17, 1914.)

METALLURGICAL FURNACE. Herbert Davison and Leonard Charles Harvey, Battersea, London, England, assignors to The Morgan Crucible Co., Ltd., London, England. (U. S. No. 1,118,534; Nov. 24, 1914.)

MINE AMBULANCE. Cornelius P. Moran, Tunnelhill, Penn. (U. S. No. 1,115,560; Nov. 3, 1914.)

MINE-CAR-DOOR LATCH-PLATE. James R. Fleming, Scranton, Penn. (U. S. No. 1,116,258; Nov. 3, 1914.)

MINE CARS—Means for Holding Cars on Mine Cages. Clarence W. Parsons, St. Louis, Mo. (U. S. No. 1,118,510; Nov. 24, 1914.)

MINING-CAR WHEEL. Alfred Bryant Day, Knoxville, Tenn. (U. S. No. 1,117,344; Nov. 17, 1914.)

MIXING APPARATUS. Utley Wedge, Ardmore, Penn. (U. S. No. 1,116,182; Nov. 3, 1914.)

MOLYBDENUM—Process for Recovering Molybdenum from Its Ores and Concentrates. Frederick D. S. Robertson, Toronto, Ont. Canada, assignor of three-fourths to Michael J. O'Brien, Renfrew, Ont., Canada. (U. S. No. 1,118,150; Nov. 24, 1914.)

NODULIZING—Process and Apparatus for Removing Adherent Material from Nodulizing Kilns. Francis Bird Dutton, Lebanon, Penn., assignor to the Pennsylvania Steel Co., Lebanon, Penn. (U. S. No. 1,117,814; Nov. 17, 1914.)

ORE DRESSING—Improvements in a Process of Dressing Ores by Means of Gas. K. Takeda, Tokyo, Japan. (Brit. No. 20,158 of 1913.)

ORE TREATMENT—Process for Treating Ores. William A. Thacher, Lake City, Colo., assignor to the Acid Process Co. (U. S. No. 1,119,473; Dec. 1, 1914.)

PNEUMATIC HAMMER. Lewis E. Summers, Detroit, Mich., assignor to Chicago Pneumatic Tool Co., Chicago, Ill. (U. S. No. 1,115,985; Nov. 3, 1914.)

QUICKSILVER—Process for Extraction of Mercury from Its Ores and other Materials. Edwin Bryant Thornhill, Gray Summit, Mo. (U. S. No. 1,119,377; Dec. 1, 1914.)

RABBLE ARM—Air-Cooled Rabble Arm. Charles C. Fisher and Hubert H. Rountrey, South Norfolk, Va. (U. S. No. 1,116,255; Nov. 3, 1914.)

RARE EARTHS—Method of Separating the Rare Earths, together with Thorium, Cerium, and Zirconium, by Electrolysis. Louis M. Dennis, Ithaca, N. Y. (U. S. No. 1,115,513; Nov. 3, 1914.)

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many others; besides the patented claims among which are some fine showings of ore; many of them have shipped.

The grant runs from seven miles north of Nogales to Tubac, the east line crossing the Sonoita River a few miles below Patagonia, the Alto postoffice being a mile north of the north line of the grant, near its northeast corner at the foot of Salero Mountain. It is described as Baca Float No. 3, and contains altogether 100,000 acres, lying in the center of Santa Cruz County, Arizona.

A speedy determination of the rights still in dispute is hoped for by all, as the state of the title has retarded the development of the whole county.

### DULUTH—Dec. 12

**Gilbert,** a village on the Mesabi range, by the decision of a suit contested in the courts for several years, is at last permitted to annex 1880 acres of valuable mining property, thereby boosting the village's assessed valuation from $275,000 to over $5,000,000. Among the suffering mines are the Gilbert and a portion of the Genoa, operated by the Oliver Iron Mining Co., the Pettit and Schley, of the Republic Iron & Steel Co., the Hobart, of M. A. Hanna & Co., and the Malta, of Pickands-Mather & Co. Annexation was bitterly contested by the mine operators.

**M. A. Hanna & Co.,** it has finally been authoritatively stated, will act as sales agents for the Great Northern production, beginning Jan. 1, 1915. The Great Northern mines now stockpiling are the Leonard, Harold, North Uno and Mississippi. Openpits being stripped are the Dean at Buhl, the Dunwoody at Chisholm and the Hill Annex at Marble. A new underground mine, the Thorne, is also being opened at Buhl. The company has no interests elsewhere than on the Mesabi range. The affiliation with M. A. Hanna & Co. has removed the uneasiness prevalent among iron ore producers as to the anticipated method of marketing this large production. M. A. Hanna & Co. are already large producers, as well as sales agents, and it is not surmised that anything will be done by them to disturb existing conditions in iron-ore circles.

### CHICAGO—Dec. 12

**The Republic Iron & Steel Co.** mining department, at Gilbert, Minn., advises that it has plans for a small mill. Although nothing has yet been done toward its construction, it is possible that work on it may start in the spring.

**Lake Superior Exploration** is at a low ebb, as evidenced by figures obtained recently from a Middle Western machinery firm. It is generally accepted that the amount of exploration under way is a fair indication of the state of the mining industry. Two years ago between 800 and 900 diamond drills were in use in the United States, Mexico and Canada. At present, in the same territory, reports indicate that only about 200 to 250 are in use. In the Lake Superior district, two years ago, there were reported to be owned about 300 diamond drills, with 110 working at the time. A report on the situation, about two months ago, showed that about 15 or 20 were then in operation. This shows beyond question a decided falling off in exploratory work during the last year or two, and checks fairly well with what is known to be true about the decline in mine development.

**Conditions around Globe, Ariz.,** according to an engineer who is operating a mine there, and who passed through Chicago on his way west recently, are better than the present average for the copper districts. Inspiration is continuing its preparatory work without slackening, and the 600-ton test concentrator, where tests on a commercial scale have been under way for many months, is still operating. It is understood that it has practically been decided to use jigs, fine grinding, and the flotation process in the new concentrator, although the names of the machines finally selected for the work have not been made public. It is reported that H. Kenyon Burch, working with another engineer, has developed a machine for fine grinding that will be used. This machine is said to have increased the recovery substantially. The history of operations at the test concentrator will form an interesting story, if the facts are ever available. The scheme itself, of building a 600-ton concentrator, for test purposes, in which it would be possible for competing manufacturers to test their machines and prove their claims on a commercial scale, with full facilities for experimentation, was a shrewd one. That it has been taken advantage of by the manufacturers is evident from the reports that have emanated from Globe and which are circulating among the makers.

**The Hill-Annex** mine on the western Mesabi is also reported as planning to build a concentrator. An engineer in Chicago recently stated that this report is probably correct. This mine will produce a large tonnage and the concentrator would probably have a capacity of 6000 tons per day. The method to be used would probably be patterned after that at the Trout Lake washery. There has been some talk on the Mesabi range, too, of the construction of a commercial treatment plant for certain ores. A plant of this sort would be of considerable interest. The Hill-Annex is being stripped by Guthrie & Co., contractors, St. Paul, Minn., and in this work they are said to be using the largest steam shovel now employed on the Mesabi range. A large manufacturer of steam shovels states that the use of such a large machine for that work is rather unusual, as there has been a tendency on the part of contractors and mining companies on that range, during the last three years, to keep away from the use of extremely large shovels. Prior to 1905 most of the shovels on the Mesabi were 65- and 70-ton machines. From 1905 to 1910, a large proportion of the shovels furnished for mining work, exclusive of those for stockpiling, were 95-ton machines. Since 1910 both the contractors and the large mining companies, the latter being the principal purchasers of the 95-ton machines, have been against the use of a shovel quite so heavy, and most of the shovels furnished since then have been either Bucyrus 85-C or Marion 76. These run from 85 to 90 tons, shipping weight, and many operators feel that such shovels are the most economical in the long run.

### CRYSTAL FALLS—Dec. 12

**The Carpenter** mine this year entered the shipping list, sending out about 50,000 tons, all from development work. The work of developing and equipping the property was carried on steadily throughout the year; a new steel head frame was erected, the necessary machinery installed and a number of dwellings built for company employees. The property is proving to be a good-sized one and will be a fine addition to the Hanna company's holdings. The work of developing the Monongahela property adjoining the Carpenter on the northwest is now being undertaken from underground workings of the Carpenter. The Carpenter installed a Curtis turbine directly connected to a General Electric dynamo and makes and transmits the electrical energy required for the Hanna company's Ravenna mine, which lies two miles to the northeast and is electrically equipped throughout. At the Hollister, the season saw the last of the Hanna company's work. This consisted of loading by steam shovel the 34,045 tons of ore remaining in stock. This was loaded directly into cars and was not put through the drier in which the product formerly was treated. All equipment has been removed, including buildings, and the lease was allowed to revert to the fee owners.

### HOUGHTON—Dec. 12

**The Total Shipments** of copper during the season of navigation by the several smelters of the Lake Superior district amounted to 90,000,000 lb. approximately. During the last seven months there has been little copper shipped by rail, except to a few manufacturing points in Wisconsin and Minnesota. The water shipments represent practically the total output from May until Dec. 1, and indicate the falling off in the output as compared to normal.

**The Tonnage-Tax** proposal will probably not be pushed this year. The state grange has backed water on the whole plan. While the proposal of some of the leaders to drop the petition altogether was not accepted and while nominally the grange continues on record as favoring the tax, the fact remains that general sentiment at the meeting was so mixed that everybody posted knows that nothing will be done. The members were ashamed to drop the proposal like a hot potato, but as a matter of fact the grangers at the meeting were convinced of the unfairness and unreasonableness of the scheme and were frank enough to acknowledge it. While the thing is out of the way for this year, it is likely to come up again next year, and the upper peninsula is getting into shape a well organized opposition to it. At the Marquette meeting, Dec. 15, it practically was decided to have a working fighting force established among nonmining corporation taxpayers of the upper peninsula, interests who realize that a tonnage tax on the mines is not only an unfair burden on the mining companies themselves but also an extra tax on the workingmen and the taxpayers who reside in mining sections. This organization will be prepared to take action whenever necessary.

### TORONTO—Dec. 12

**A Shortage of Pebbles** for the mills of Porcupine and Cobalt was lately experienced on account of the cutting off of supplies from France and Denmark. The difficulty has been overcome by the bringing in of 39 carloads of Newfoundland pebbles.

# The Mining News

## ALASKA

TELLURIDE SAND, near Nome, reported as found recently by R. A. Miller on Brunside Creek in Candle country.

## ARIZONA

### Pinal County

KELVIN-SULTANA (Kelvin)—Directors recently voted to resume operations at mine after shutdown of 30 days. Mill will not be operated at present, all energies being directed to extensive development work on 500-ft. level. New undertaking calls for about 5000 ft. of work to south of Westfall shaft, opening up ground hitherto unexplored. Condenser to be added to power plant and numerous improvements in equipment made at mines. New compressor of 1000-cu.ft. capacity to be installed at once.

### Santa Cruz County

O. K. (Tubac)—Work progressing regularly with about 25 men. About 10 tons per day extracted and shipped to El Paso. Ore said to net about $10 per ton, and operation is paying its way. Ore shipped is carbonate, but thought market will be found shortly for sulphide, of which there are large quantities in sight. Some permanent improvements now under consideration will begin soon.

FLUX (Patagonia)—Messrs. Collie and Bierce have taken possession; so far have done only exploratory work; contract calls for mill, and now announced this will be built in Flux Cañon, just below mouth of what is called the lower tunnel. County road passes along near mouth of shaft above, and spur will be run down cañon to hit road at lower level.

## CALIFORNIA

### Amador County

ORIGINAL AMADOR (Amador City)—Dam for impounding mill trailings is being constructed three miles west; will be 30 ft. high, said to be capable of holding 1,000,000 tons.

### Calaveras County

HARDY-McCREIGHT (Angels Camp) — Reported large amount of high-grade ore extracted recently from depth of 125 ft. Mine under bond to James and David Maltman, who have been operating for two years.

### Eldorado County

GREENWOOD DISTRICT, sometimes known as Garden Valley, attracting locators of mining claims and water rights. Reported W. E. Gill and D. L. Shepard contemplate installation of mill of five to 10 stamps on property partly developed.

INVINCIBLE MINES CONSOLIDATED (Placerville)—This property, including claims in Horseshoe Bar and Volcanoville districts which extend into Placer County, and other claims in vicinity, sold to John A. Britton, of San Francisco. Property covers large area. Purchase price not made public as yet.

### Kern County

AMALIE-CALIENTE MINING & MILLING CO. (Amalie)—Five-stamp mill being installed for treating custom ore in Amalie district.

BLUE MOUNTAIN MINING CO. (Woody)—Ten-stamp mill completed. Old workings cleaned out; some ore extracted.

### Mariposa County

MOUNTAIN KING (Mariposa)—Power dam completed Oct. 31; expected to have plant finished by Dec. 15. New flume part of equipment. Moving mill to point near main working tunnel contemplated, also installation of electric tramming instead of mules. Estimated improvements will reduce cost of mining and milling to $2.25 per ton.

### Nevada County

MARYLAND GOLD QUARTZ MINING CO. (Grass Valley)—Bond held by Idaho-Maryland Development Co. surrendered and property reverted to owners.

UNION HILL (Grass Valley)—Reported high-grade ore encountered in two places in mine; believed 20-stamp mill will soon go into commission. One find, free-milling ore, at 710 ft. depth, other on 300-ft. level.

### Placer County

GARDELLA DREDGE (Lincoln)—Expected dredge will be completed by end of year. Will have 5-cu.ft. buckets. Hull 90 ft. long and 40 ft. wide.

### Shasta County

MAMMOTH (Kennett)—Baghouse improvements nearing completion. Cost will be about $110,000. Approximately 500 tons of structural steel used. Additional miners expected to be put on to keep up ore reserve for plant.

### Tulare County

TULARE MINING CO. (Porterville) — Preparations being made to test new magnesite grinding mill manufactured by John Horstmann & Co., of San Francisco. Magnesite mine now employs 35 men.

### Tuolumne County

BLUE EAGLE (Sonora)—New compressor, gasoline engine and drills being installed. Owing to inaccessibility of Jawbone district machinery had to be packed over by animals and sleds. C. Lumsden superintendent.

McALPINES MINES CO. (Sonora)—New corporation organized with capital stock of $1,500,000. Directors are Frank R. Whitcomb, C. L. La Rue, M. C. Hassett, of San Francisco, A. R. D. Barnard, of San Anselmo, and Fannie W. McLean, of Berkeley. Head office, San Francisco.

## COLORADO

### Boulder County

COLORADO METALS & CHEMICAL CO.—Consolidation with Consolidated Copper Mining, Milling & Smelting Co. announced. Companies own properties in Boulder and Grand Counties, formerly known as Fourth of July group.

WHITE RAVEN (Ward)—Mine in fine condition, but Manager Ewing restricting production to cover operating expenses only until price of silver advances materially. Is pushing development and has blocked much ground running high in silver.

MACKEY (Boulder)—Mill being overhauled and placed in condition to make test run on ore recently taken from mine. If results are favorable company will consider sinking to greater depth and driving drifts on vein. John McColl, of Idaho Springs, in charge of operations.

GOLD HILL DEEP (Rowena)—Loveland and Boulder business men have organized this company. Under management of R. G. Hackett, High Line adit will be driven to intercept numerous veins traversing property which comprises 17 lode claims and millsite on Left Hand Creek.

CARDINAL (Cardinal)—Mill has been undergoing numerous changes in equipment. Policy of Henry T. Lowe, manager, to test machines and methods on commercial basis rather than on small laboratory scale. Now believes research has proceeded far enough to continue regular operations with following equipment: Blake crusher, 10 stamps, 12x6-ft. tube mill, 4½-ft. Hardinge mill, five Card tables, two Wilfley slimers, 12 canvas or "rag" tables.

### Clear Creek County

ANNAMOSA (Georgetown)—Recently purchased by E. G. Hurst, of Denver, who is making arrangements for active development.

ONEIDA-STAG (Idaho Springs)—New 50-ton cyanide mill ran well in week's tryout; now in regular commission treating large quantity of ore previously stocked.

MIXSELL MILL, Idaho Springs, purchased by Edgar L. Payne, manager of Seaton Mountain and Idaho Bride mining properties. Will hereafter treat his own ores as well as conduct custom business.

BIG FIVE TUNNEL (Idaho Springs)—About 1200 cars of ore transported during November and delivered to Newton and Jackson mills. Five sets of lessees engaged in development and mining operations through tunnel, employing about 40 men.

MEMPHIS & IDAHO SPRINGS GOLD MINING CO. (Idaho Springs)—Property between Gem and Sun & Moon mines on line of Newhouse tunnel, leased to group of operators from Denver. Active development work will be carried on through tunnel.

ARGO MILL (Idaho Springs)—Supply of ore from mines working through Newhouse tunnel up to mill's capacity and additional machinery being installed in preparation for larger business. New machines include tube mill and 80-ton Portland filter. Among mines sending ore to this mill are Gunnell, Gem, Golden Edge, Kansas and Pozo.

PRIMOS MINING CO. (Idaho Springs)—Company plans to continue vigorous development work throughout winter. New buildings completed, including bunkhouse and compressor plant; compressor installed and ready for operation. New adit started 300 ft. above compressor plant and necessary air lines laid. Last 200 ft. of development encouraging. About 50 men will be employed on property.

OLD TOWN (Idaho Springs)—Development on 1300-ft. level encouraging during past month. Vein widened from 1 ft. to 4, with average assay value given as $15. Probable this oreshoot is same as the one opened above on 1100-ft. level. Company will advance 1500-ft. level about 300 ft. to prospect for same shoot. On 1100-ft. level winze sunk 60 ft. in payable ore. Possible ore reserve now estimated at 100,000 tons ranging from $5 to $10. Geo. K. Kimball manager.

NEWHOUSE TUNNEL (Idaho Springs)—During month past development and production increased in properties operated through tunnel. In November tunnel company handled average of 300 tons of ore a day, which was treated in the Argo and Newton mills. Argo mill produced four cars of concentrates per week. Several new leases granted and increased development anticipated. Properties tributary to tunnel now employing about 150 men. Additional equipment being installed in Argo mill, which will result in considerable increase in capacity. Includes tube mill and filtering apparatus.

STANLEY MINES CO. (Idaho Springs)—Three of placer claims belonging to this company leased to James W. Myers, who is installing Cornish pump to unwater shaft west of compressor plant. Pump will be operated night and day by steam and shaft will be unwatered to bedrock, distance of about 40 ft. Two years ago these placers were worked by James E. Bowden with encouraging results. Stanley dumps and Salisbury mill leased to Thomas M. Egan, of Idaho Springs. Tramway installed to convey material from dump to mill. Mill overhauled; some additional equipment will be

added, including stamps, plates and Egan concentrating tables. Water-power plant which operates mill has been placed in working order. Lessee contemplates treatment of custom ores in addition to ores from dumps. Road adit level of Stanley mines being cleaned out and retimbered on company account preparatory to resumption of development on this level. Company plans to advance this adit along Stanley vein into Spring Gulch territory. Development operations on company account under direction of Harry J. Wolf, consulting engineer.

**Gilpin County**

BURROUGHS (Central City)—Block of ground 300x500 ft. leased to Messrs. Morrison, Ulrich & Horn. Lessees now equipping property to carry on operations through Newhouse tunnel.

**Lake County**

LITTLE BOB (Leadville)—George Campion, veteran operator, has secured long-time lease and is removing ice and water from workings he drove years ago.

NORTH SIDE (Leadville)—New shaft started by W. J. Davis has finally reached bedrock. Wash 115 ft. deep, 30 ft. more than ever before disclosed on Pryor Hill.

**San Miguel County**

LAKE SUPERIOR-OPHIR MINING CO. (Ophir)—This company, which operates Calumet property, will install two-bucket tramway between mine and mill.

TOMBOY (Telluride)—New cyanide mill in Savage Basin nearly completed, may start this month. Provision made for strict economy in use of water, scarce during winter and late summer.

SUFFOLK (Ophir)—Mill being overhauled and repaired by lessees. Two bumping tables added to equipment; air compressor placed in working order and now operated by water power. Ore being delivered to mill.

ALTA—Active production discontinued. Reported ore reserves are ample but owners do not desire to mine while silver price is low. Development work in Palmyra crosscut will continue. Management considering advisability of installing cyanide treatment in mill.

**Summit County**

HELEN (Breckenridge)—Small plant in which crushing unit is Huntington mill almost ready to run. Aërial tramway will be erected to deliver ore from adit, 1400 ft.

**Teller County**

ECONOMIC (Cripple Creek)—Dump leased to H. C. Harris and W. E. Vansant. Material being sorted and shipped to Copeland sampler at rate of about one car a day.

COPELAND ORE SAMPLING CO. (Cripple Creek)—Company has completed addition to its ore-sampling plant of department designed to take care of high-grade ores. New equipment includes crusher, rolls and grinder. Small smelting furnace added to handle rich ores and zinc slimes.

## IDAHO

FRISCO (Frisco)—This property, acquired about two years ago by Federal Mining & Smelting Co., reopened last week after shut-down of about six months. Immediately after purchase from D. M. Hyman, of New York, who held title through foreclosure sale, extensive improvements were made. Mine, which had been filled with water for several years, pumped out, requiring approximately six months' time; shaft retimbered; various levels put in working shape; old mill repaired and new machinery added. Active mining operations then begun and force increased as work progressed. Considerable trouble experienced from start with the milling operations, owing to refractory character of ores. Plant operated for some time, but no ore shipped by company, then mine again closed down. Since then, mill practically rebuilt and dry magnetic system successful in other mining districts, but never attempted in Cœur d'Alenes, installed. Understood mine is opened only for experimental run of one month. At end of that time operations will be thoroughly checked over, and continuation will depend a great deal upon success of new milling facilities and upon metal prices. Frisco, in early days one of big producers of district, acquired by Federal for $100,000, and in addition purchasers agreed to expend $150,000 in unwatering and equipping it. Federal to take back from earnings of mine $250,000, and thereafter entitled to one-half proceeds, remaining one-half reverting to Hyman. At time of purchase estimated that ore reserves amounted to approximately $242,000. Up to Aug. 31, 1913, Federal had expended $118,476 in placing mine in working shape; evident that considerable more than $150,000 has been spent up to present time.

## MICHIGAN

**Copper**

NAUMKEAG (Houghton)—Continues exploration of Pewabic lode branch, opened for 1300 ft. Unbiased miners claim this has commercial assurance of success. Management refuses to talk.

TAMARACK (Calumet)—Absolutely no operations except in construction of regrinding plants for mill sands, isolated instance of Calumet & Hecla's construction work in county. Best Tamarack miners given jobs as trammers at C. & H. Red Jacket shaft.

AHMEEK (Ahmeek)—Running two shafts, Nos. 1 and 2. Costs lower than ever before and rock running 24 lb. North Ahmeek shafts, 3 and 4, shut down since war started, boilers simply caring for water. No intention of resumption. One Calumet & Hecla subsidiary that is making good profit. Dividend possible.

MOHAWK (Mohawk)—Making a little better than 1,000,000 lb. copper a month. This figure will be exceeded in December by at least 300,000 lb. if present rate is continued. Largest output Mohawk ever showed and cost of production lower than ever before. Recovery of copper raised from 15 lb. to 18. Coming to point where it will rival and outclass even Wolverine in earning possibilities and quality of rock. At present management is bending energies to increase output from No. 5, one of southerly shafts. Quality of rock from this shaft better than average secured from northerly shafts. No. 6 shaft producer only in limited way, is sending up best rock Mohawk has found anywhere.

TRIMOUNTAIN (Trimountain)—Mine continues to make regular shipments of one- and two-ton lot chunks of copper from what is unquestionably richest and largest mass of copper ever found anywhere. This mass was first cut a year ago, 50 ft. above 25th level, has average lateral distance of 40 ft. with thickness of about 8 in. Has been opened for over 250 ft. to date, beyond the 27th level and there is no sign of its pinching out. Runs 95% copper. Two miners chisel on it all the time, using coal chisel attached to air riveter. Wages paid out of chips which fall from chisels. Some miners claim this is not mass but rather fissure, but there is not much chance for dispute on subject, as formation is continuous and appears in footwall. Similar formation was once found at No. 11 shaft of Calumet & Hecla in conglomerate. It ran for eight full levels, but frequently broke out and would not show for a few feet, and then would be found again. At Ahmeek, in one shaft, fissure of practically solid copper was picked up right at first level and followed down to 16th level, in hanging wall. It was rich and fat.

**Iron**

WAKEFIELD (Wakefield)—Butler Bros. will finish stripping contract by Jan. 1, and remainder of stripping will be done by operators, M. A. Hanna.

AMERICAN (Diorite)—Closed Aug. 1 for repairs, will open again Dec. 15 with full crew. Some ore will be shipped during winter by rail to Algoma Steel Co. at Canadian Soo.

ASHLAND (Ironwood)—One of few mines on Michigan ranges working with full force. About 350 men employed. All ore in stock shipped and company looks for another good year in 1915.

## MINNESOTA

**Cuyuna Range**

CUYUNA-SULTANA (Ironton)—Air compressor being installed. Construction on headframe for No. 2 shaft will begin in few days.

WILCOX (Brainerd)—Mine drowned out due to succession of pump troubles. Added equipment now overcoming trouble, and mine will be unwatered in few days.

**Mesabi Range**

EATON (Buhl)—Mine will soon be reopened. Should produce probably 50,000 tons annually. New leaseholder, the Robertson-Hoar Co., has subleased to Captain Hoar, who proposes to operate property on profit-sharing plan. Mining cost will be placed at certain figure, beyond which company will bear excess. Mine has been idle for some time, largely, it is claimed, on account of several restrictive clauses in former lease, which owners have now removed.

**Vermilion Range**

McCOMBER (Tower)—Mutual Iron Co., operators, state this mine will stockpile throughout winter.

## MISSOURI-KANSAS-OKLAHOMA

THE DEEPEST ORE of any importance discovered in the Baxter, Kan., district just made in drill hole put down by T. F. Lennan, on the line between Miami Lead & Zinc Co. and the Lennan Lead & Zinc Co. Drill put to work northwest of the deep pump shaft, where mining operations are being conducted at depth of 320 ft. Orebody from shaft dipped to northwest and it was to determine extent of pitch that drill hole was put down. Zinc and lead encountered at 320-ft. level continuing down to 370-ft. level, with drill still in ore.

BLACK HILLS MINING CO. (Galena, Kan.)—Operations resumed after shutdown of two months to install new gas engine and make other needed repairs; mill now running steadily from two mines on land on which it is situated. Fred Stone superintendent.

McDONALD MINING CO. (Joplin, Mo.)—Company purchased 300-ton mill of Portland Mining Co., and is moving it to leasehold on Connor land south of Carterville. Extensive sheet-ore formation opened there by McDonald company. Proposed to have reconstructed mill in operation in 60 days.

LOCKPORT (Galena, Kan.)—This property, on Windsor land, has shut down mill and mine to make repairs on mill and mill shaft; will install larger pumps to handle water which has become serious since heavy rains. Situated along Short Creek and during the heavy rainy season creek overflows mines. James Murphy owner.

## MONTANA

**Lewis and Clark County**

FRED B. HALL reports finding strong lode on left side of Ten-Mile Creek, eight miles north of Rimini, at head of Little Bear Gulch.

**Silver Bow County**

BUTTE & SUPERIOR (Butte)—Repairing of shaft rapidly nearing completion. Manager Bruce hopes to start work again by end of December, which will mean the employment of 900 or 1000 men. On Sept. 17 when mine and mill closed down, throwing several hundred men out of employment, men remaining at work conceived idea of organizing among themselves to help out fellow miners who might need assistance. Organization formed with Paul Hudtloff as secretary-treasurer. Nearly every man remaining in employ of company gave portion of wages to proposed fund, which was turned over to safety-first committee entrusted with finding out who needed help. Plan was on loan basis. When resuming work, men will pay back to relief fund amount received in line of assistance. Result has been to bring about closer and more friendly relation among employees than ever existed before.

## NEVADA

### Esmeralda County

ATLANTA (Goldfield)—Unwatering completed Dec. 1. Considerable exploratory work will be done to find Jumbo Extension oreshoot on dip.

SAMPLER FOR GOLDFIELD may result from recent strike in Jumbo Extension, according to statement of Frank M. Manson, manager Western Ore Purchasing Co. Columbia sampler may be rebuilt or new one built.

### Humboldt County

NEVADA PACKARD (Rochester)—Regular shipments of 300 tons ore per month made to Hazen plant of Western Ore Purchasing Co.; ore mined in tunnel C, assays 100 to 230 oz. silver and $2.50 gold per ton. Same shoot being opened on new level. Nevada Short Line now hauls this ore; temporary terminal established in Rochester Cañon.

### Lander County

COPPER STRIKE IN COPPER BASIN, eight miles from Battle Mountain, made. Stated shaft sunk 250 ft. in porphyry assaying 2% copper. Ore easily concentrated; tests being made at University of Nevada. Development work will be continued all winter.

### Nye County

TONOPAH EAST END (Tonopah)—Power line extended to shaft house and electric hoisting now done.

HALIFAX (Tonopah)—Shaft will be retimbered from 400- to 700-ft. level; Oregon white cedar will be used.

JIM BUTLER (Tonopah)—Retimbering shaft to depth of 700 ft. just completed. There is installed double-drum Nordberg hoist operated by 125-hp. variable-speed motor.

CASH BOY (Tonopah)—Reorganization effected. Articles of incorporation filed with secretary of state; Carson City principal place of business; capitalization 2,000,000 shares of $1 each. Name, Tonopah Cash Boy Consolidated Mining Co.; will operate property in western zone of Tonopah district.

MONITOR BELMONT (Manhattan)—Installation of power line from Manhattan station to old camp of Belmont about completed. Understood mining machinery has been ordered by company and will be installed without delay. First work will be unwatering of deepest shaft in Belmont district, now containing over 300 ft. of water in its 500-ft. depth.

BIG PINE (Manhattan)—Equipment for new mill of Mushett & Wittenberg now en route between Tonopah and Manhattan. Heaviest single piece of machinery, tube-mill shell, weighs 14 tons. Haul from Tonopah being made with team of 18 horses across flat and when hill-climbing commences additional team of 10 horses will be added. At mill site, concrete in place for tube mill, and three shifts of workmen preparing for rapid installation of machinery when it arrives. Water tanks and 4½-in. pipe line from Union Nine ready.

### Mineral County

IN GOLDYKE DISTRICT north of Luning several leases given on good property and long delayed work started on others.

FRANK EVERETT and associates have financed large holdings of H. H. Hill and C. Barr of Nevada Silver Peak and will erect mill at once on ground. Property lies about eight miles northwest of Luning, consists of four claims having series of well defined veins varying from 2 to 46 in. in width and carrying gold.

## NEW MEXICO

### Grant County

STAUBER & WRIGHT (Pinos Altos)—Force increased and two shifts put to work on high-grade shoot.

McKENNA & GERHART (Hanover)—Will begin extensive leasing on promising mines below Hanover. Work on Mountain Home group discontinued temporarily.

EMPIRE ZINC CO. (Silver City)—Grading for nine-mile tramway begun with large force of men; 50-ton electrostatic mill to be erected at Cleveland mine; concentrates to be hauled to Santa Fé. Power generated at Hanover.

85 MINE (Lordsburg)—Company shipping reduced output. Meeting of directors Dec. 10 will govern immediate policy. Approximately 60 men employed. New electrical hoist, etc., may be installed. W. F. Ritter in charge.

### Lincoln County

BENDER MINES (Carrizozo)—Active development to be commenced by J. C. Bender on claims between Helen Rae and American Lode when power line is completed. Latter two properties may again become producers if present plans are carried out.

### Socorro County

SERIES OF MISFORTUNES seems to be pursuing Mogollon mail contractor. Valuable pouch disappeared recently from auto, and Dec. 2 leaky gasoline tank ignited, causing total destruction of car.

## OREGON

TITLE TO PLACER land involved in suit of Mrs. D. E. Richen and Curtis Haley against Titus Davies decided in favor of plaintiff establishing claim to 10 acres of placer ground near Sumpter. Decision stated clearing of land of timber by Mrs. Richen was legitimate assessment work on placer ground, inasmuch as ground is better suited for dredging than for other methods of working and must be cleared of timber as first step to put in condition for dredging.

RAWLEY COPPER (Drew Creek)—Mine recently sold to D. Van Ostrand, of Milwaukee, Wis., for $35,000. New owner now developing property.

OREGON-IDAHO INVESTMENT CO. (Mormon Basin)—Humboldt mine being extensively developed by company, management having just completed sinking shaft to another level; station now being cut to start drifting on vein. Preparations being made to start up mill soon.

QUEEN MINING CO. (Leland)—Cyanide plant installed last summer under direction of W. A. Burr, has had successful test on 60 tons of ore. Capacity 30 tons.

OLD CHANNEL (Galice)—This, one of best known placer mines in Southern Oregon, on Galice Creek, sold for $65,000 to H. K. Owens, C. L. Creelman, and John C. Eaton, of Seattle. New owners will start work at once, it is said.

POWDER RIVER GOLD DREDGING CO. (Sumpter)—County court granted petition to operate dredge through county road near Sumpter, petitioners agreeing to replace highway and pay $50 for privilege. Dirt now mined said to pay better than at any time in previous history.

## UTAH

### Juab County

TINTIC DEVELOPMENT (Mammoth)—Hoist and machinery at this company's Sioux-Ajax claims being loaded and shipped to Yampa mine at Bingham. Two properties owned by same men.

### Summit County

SNAKE CREEK TUNNEL (Park City)—November showed progress of 388 ft. New Bury compressor and motor installed. Country rock hard marbleized limestone. No diorite encountered, though it forms surface rock above tunnel. Face dry most of month, but at 9800-ft. point water encountered. Flow at portal about 450 gal. per min.

### Tooele County

MOZART (Wendover)—Operations to be resumed; men and provisions sent out for winter work. Tunnel will be driven to cut vein.

## WASHINGTON

HECLA (Chewelah)—Company now has boiler, hoist, compressor and other equipment; will sink 200 ft. to first level.

WESTERN UNION (Republic)—Lease and bond on Insurgent, "V" Fraction and Ireland mines given by G. B. Dennis, of Spokane, for $125,000. This completes arrangements for development of entire Republic group. Mining now under way on Insurgent and Ireland properties, payment of lease and bond to Mr. Dennis to be made on tonnage basis.

## WISCONSIN

KITTOE (Benton)—Vinegar Hill Zinc Co. reassembling Masbruch mill on this new property.

CHAMPION (New Diggings)—New mill of Wisconsin Zinc Co. made initial run showing capacity of 400 tons of mine dirt in 10 hours.

THOMPSON (New Diggings)—New shaft 6x15-ft., three-compartment, being sunk and 250-ton mill will be erected by Field Mining Co.

WEST HILL (Platteville)—This new property making good; first two cars of concentrates produced assayed over 55% metallic zinc.

## CANADA

### Ontario

ELLIS CLAIMS in Kirkland Lake district report good gold discovery.

LA ROSE (Cobalt)—New shaft on Extension down 150 ft. and will be continued till contact with Keewatin is reached.

BUFFALO (Cobalt)—Property resumed operations Dec. 7. Low-grade mill again treating ore and operations will be on same scale as existed before shutdown.

MILLER LAKE-O'BRIEN (Gowganda)—Board of conciliation appointed by Canadian government to inquire into dispute over wages between owners and employees, reports all danger of strike averted.

JUPITER (Schumacher)—Option dropped by McKinley-Darragh. Terms option called for payment on Dec. 17 of $50,000 to retire outstanding bonds. Development of property will be continued by Jupiter company.

### Yukon

YUKON GOLD (Dawson)—Company preparing to handle thousands of cords of wood this winter for thawing next summer; 2000 cords will be hauled to Bonanza; 3000 cords to dredge No. 9 on 21 Eldorado and N. A. T. & T. claim; several hundred cords to dredge No. 8 on 24 above Bonanza. Wood will also be hauled to dredge No. 1 near mouth of Bonanza and 6000 cords to dredge No. 6 on lower Gold Run.

CANADIAN KLONDIKE (Dawson)—Further details in regard to world's record recently established by dredge No. 3 operating in Bonanza Basin, when 110,045 cu.yd. of material was handled in one week, show that it was in operation 163 hr. 51 sec. with loss of time of 4 hr. 9 min., divided between operation 4 hr. 3 min. and repairs 6 min. Yardage per operating hour, 674; kilowatt-hours used, 106,000; kilowatt-hours per cu.yd., 96; average width cut, 280 ft.; average depth cut, 30.6 ft. Crew of dredge: Arthur Gibson, dredgemaster; Joe McKinnon, Stanley Gibson, Geo. Munroe, winchmen; James Forbes, oiler. Dredge built in 1913. New bucket line put on recently and bucket lips built up extra 2 in., thus giving capacity of 17 cu.ft. instead of 16 cu.ft. as originally designed.

## CENTRAL AMERICA

### Costa Rica

AGUACATE MINES (San Mateo)—Orebody now opened on seventh level for about 1200 ft. Ore milled in November averaged $28 per ton. Bonanza ore encountered between 550-ft. and seventh levels; this will be sorted and after preliminary treatment sent to U. S. smelters. Manager Spilsbury expects shortly to ship 50 tons averaging $2000 per ton.

## BELGIAN CONGO

DIAMOND MINES still working; no suggestion of stopping.

COPPER MINES, contrary to report, not closed down; employees drawing half pay, remainder put in bank at 5%. Railroad construction work, which had reached kilometer 220, stopped.

# The Market Report

## METAL MARKETS

**NEW YORK—Dec. 16**

Copper and tin have been strong and advancing. Spelter and lead have been sluggish. In all the metals the present prices ought to be satisfactory to everybody, considering the conditions.

### Copper, Tin, Lead and Zinc

**Copper**—A large business was done during our last week of record, each of the important selling agencies reporting transactions of millions of pounds. These were both for domestic and foreign account. England and France were buyers. The effect of the increased demand, which was genuine, was an advance of price, but this natural movement happening to coincide with resumption of trading in stocks in Broad Street, the daily papers indulged in rather flamboyant stories. The market was good, but not quite so good as pictured. There has been a wonderful recovery in copper but harm is done if anybody be led to forget that the industry is still on a 50% basis.

During the last two days some small sales were made at 13½c., regular terms, but the bulk of the business was done at 13⅜c., delivered, 30 days, in this country and at £62, less ½%, or about 13.40c., delivered in Europe. At the close copper was easily available on those terms, although some sellers were holding at 13½c. regular terms, and were indisposed to go below that.

A well informed estimate of the present consumption of copper in this country is 40,000,000 to 50,000,000 lb. per month. Estimating exports at 40,000,000 lb., deliveries are probably well ahead of current production.

Producers selling copper to Europe find it hard to reckon nowadays what they are going to realize; exchange, freights, insurance and war risk being such uncertain factors. The differential between c.i.f. London and f.o.b. New York is variously reckoned at ¼ to ⅜c. per lb., which is materially higher than the normal in ante-bellum times. Producers do not like to make a simple price f.o.b., New York, and let the foreign buyer do the figuring because of competition among themselves and the inability of the foreigners (or their supposed inability) to manage the machinery of the business so well; but if there were a single selling agency for export business, a change of that sort would be very likely to develop. Already some business with the neutral countries, which has become especially troublesome, is being done in that way.

Copper sheets, base price was advanced ½c. on Dec. 15, and is now 18½c. per lb. for hot rolled and 19½c. for cold rolled. Usual extras charged and higher prices for small quantities.

In the British House of Commons on Nov. 26, Sir Edward Grey, replying to Sir J. D. Reese, said that copper had been declared absolute contrabrand. Any copper shipped for an enemy through a neutral country was therefore liable to seizure and confiscation, and His Majesty's Government is effectively exercising its belligerent rights accordingly.

**Tin**—Spot supplies in New York being very small, a Russian inquiry for a few hundred tons which came into the market about the end of the last calendar week tended to advance prices materially. Futures, which are selling at a considerable discount, did not attract consumers and the business done was small in volume.

**Lead**—This market was again very dull and the price is a shade easier. A declining tendency is scented in the trade. Another Russian inquiry for a large tonnage of lead was in the market this week.

**Spelter**—Domestic demand continued to be conspicuous by its absence and the foreign demand became rather sluggish after certain large transactions in the early part of our week of record. London quotations indicated an ability of sellers to realize better than the market here, but just what the seller is going to realize on contracts for future deliveries abroad is an uncertain factor. Anyway the late London quotations seem to have been but nominal inasmuch as sellers who tried to realize them could not do so. A considerable business in brass specials was done.

Zinc dust is quoted at 10c. per lb., New York.

**Aluminum**—The market has been dull and rather easy. Some inquiries reported, but few sales. Quotations around 19c. per lb. No. 1 ingots.—**Antimony** is again quiet, with small business doing. Ordinary brands are 13@13½c. per lb., while 16@17c. is asked for Cookson's.—**Quicksilver** is quiet but strong, and quotations remain $52.50 per flask of 75 lb. in New York. London price is £11 10s. per flask.—**Nickel**—Ordinary forms—shot, blocks or plaquettes—are 40@45c. per lb., according to size and terms of order. Electrolytic metal is 5c. per lb. higher.

DAILY PRICES OF METALS

NEW YORK

| Dec. | Sterling Exchange | Silver, Cts. per Oz. | Copper: Electrolytic, Cts. per Lb. | Tin: Cts. per Lb. | Lead: New York, Cts. per Lb. | Lead: St. Louis Cts. per Lb. | Zinc: New York, Cts. per Lb. | Zinc: St. Louis, Cts. per Lb. |
|---|---|---|---|---|---|---|---|---|
| 10 | 4.8700 | 49⅞ | 12.60 @12.70 | 32¾ | 3.80 | 3.67½ @3.70 | 5.65 | 5.50 |
| 11 | 4.8745 | 50 | 12.70 @12.80 | 33½ | 3.80 | 3.67½ @3.70 | 5.65 @5.67½ | 5.50 @5.52½ |
| 12 | 4.8713 | 49⅞ | 12⅞ @13 | 34 | 3.80 | 3.67½ @3.70 | 5.65 @5.67½ | 5.50 @5.52½ |
| 14 | 4.8700 | 49⅞ | 12⅞ @13 | 34¾ | 3.80 | 3.65 @3.70 | 5.65 @5.67½ | 5.50 @5.52½ |
| 15 | 4.8706 | 49¾ | 13.15 @13.20 | 34¾ | 3.80 | 3.65 @3.70 | 5.65 @5.67½ | 5.50 @5.52½ |
| 16 | 4.8713 | 49⅞ | 13.15 @13.20 | 34½ | 3.80 | 3.65 @3 70 | 5.65 5.67½ | 5.50 @5.52½ |

The quotations herein are our appraisal of the markets for copper, lead spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.15c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumer, and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business and 0.25 to 0.37½c. on European. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

LONDON

| Dec. | Silver | Copper: Spot £ per Ton | Copper: Spot Cts. per Lb. | Copper: 3 Mos. | Copper: Best Sel'td | Tin: Spot | Tin: 3 Mos. | Lead: £ per Ton | Lead: Cts. per Lb. | Zinc: £ per Ton | Zinc: Cts. per Lb. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 23⅛ | 56⅝ | 12.30 | 56⅞ | * | 146 | 145 | 19½ | 4.18 | 28½ | 6.14 |
| 11 | 23⅛ | 57⅛ | 12.53 | 57⅜ | * | 147 | 146 | 19½ | 4.18 | 28½ | 6.14 |
| 12 | 23 1/16 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 14 | 23 1/16 | 58½ | 12.66 | 58⅜ | * | 150½ | 149½ | 19½ | 4.18 | 28½ | 6.14 |
| 15 | 23 | 58⅜ | 12.68 | 58⅛ | * | 149½ | 148¾ | 19½ | 4.18 | 28½ | 6.14 |
| 16 | 22 15/16 | 57⅜ | 12.55 | 58 | * | 149½ | 148 | 19⅛ | 4.16 | 28 | 6.08 |

*No quotations.

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26¼c. = £25 = .44c.; £50 = 10.88c. Variations, £1 = 0.21¾c.

**Bismuth**—Current sales have been at $2.75 per lb., New York.

**Selenium**—Quotations are $2@3 per lb. for larger quantities; $4.50@5 per lb. for smaller lots.

## Gold, Silver and Platinum

**Gold** exports from Germany have been absolutely prohibited. Penalties of fine and imprisonment are provided for violations of this rule.

Total transactions in gold bars at the New York Assay Office in November amounted to $3,108,843, being $4,233,199 less than in October. For the 11 months ended Nov. 30, the total was $31,699,074 in 1913, and $58,869,980 in 1914; an increase of $27,170,960 this year.

Gold production in the Transvaal in November is reported at 715,886 oz., against 733,746 oz. in October and 673,486 oz. in November, 1913. For the 11 months ended Nov. 30 the total output was $167,881,926 in 1913, and $158,807,631 in 1914; a decrease of $9,074,295, or 5.4%, this year.

**Silver**—Owing to English Mint purchases and moderate buying on India account, price of silver has been fairly well maintained. Conditions in Mexico are improving somewhat from the mining interest point of view.

**Platinum**—The market is weak and uncertain, with business moderate only. Quotations for refined platinum are $42@43 per oz. Hard metal is $46@49 per oz., according to quality.

## Zinc and Lead Ore Markets

**PLATTEVILLE, WIS.—Dec. 12**

The base price paid this week for 60% zinc ore was $47 per ton. The base price paid for 80% lead ore was $46 per ton. No shipments of lead were reported.

SHIPMENTS WEEK ENDED DEC. 12

| | Zinc Ore, Lb. | Lead Ore, Lb. | Sulphur Ore, Lb. |
|---|---|---|---|
| Week | 4,302,520 | ..... | 336,100 |
| Year | 160,208,340 | 4,998,890 | 31,247,650 |

Shipped during week to separating plants, 4,343,190 lb. zinc ore.

**JOPLIN, Mo.—Dec. 12**

Blende, high price, $50; assay base, 60% zinc, $46@48.50; metal base, 60% zinc, $44@45; calamine, base, 40% zinc, $22.50 @24.50; average, all grades of zinc, $44.78 per ton.

Lead, high price, $49; base, $47@48 per ton, 80% metal content; average, all grades of lead, $47.22 per ton.

The week's shipment is the largest in pounds of blende and galena of the entire year, and the value is the largest of any week of the year. Even with prices steadily advancing the demand for blende and calamine grows stronger.

SHIPMENTS, WEEK ENDED DEC. 12

| | Blende | Calamine | Lead | Values |
|---|---|---|---|---|
| Totals this week.. | 12,138,350 | 789,570 | 2,383,590 | $345,780 |
| Totals this year.. | 492,602,810 | 37,264,070 | 85,427,810 | 12,328,200 |

Blende value, the week, $279,560; 50 weeks, $9,896,220.
Calamine value, the week, $9980; 50 weeks, $439,170.
Lead value, the week, $56,240; 50 weeks, $1,992,360.

# IRON TRADE REVIEW

**NEW YORK—Dec. 16**

The iron and steel markets continue to show an improved tone, although the end of the year is approaching when there is usually a **lull** in business.

Exports from Baltimore, Nov. 11, included 12,886,657 lb. iron pipe and fittings to Abadan, Persia. This is an unusual destination for such exports.

Official announcement was made Dec. 14, that because of unsettled financial and industrial conditions, the United States Steel Corporation has decided not to offer its stock to employees for subscription in 1915. The practice of offering stock for the subscription of its employees was instituted by the Steel Corporation as far back as 1903, and this will be the first year since the profit-sharing plan became operative in which the employees will not have the privilege of subscription.

Imports at Baltimore for the past week included 30 tons Spiegeleisen and 1600 tons ferromanganese from Middlesboro, England.

**United States Steel Corporation** reports unfilled orders on its books on Nov. 30 at 3,324,592 tons of material; which compares with 3,461,097 tons on Oct. 31, 4,932,857 tons on June 30, and 4,396,347 tons on Nov. 30, last year.

**PITTSBURGH—Dec. 15**

The steel situation has shown further improvement, though the progress is slow. There are heavier bookings of orders for immediate shipment, but the total is still small, and not sufficient to occasion any increase in mill activity. The steel mills as a whole are operating at about 35% of capacity and instead of increasing this rate shortly will close down over the holidays in many cases. January, however, may see a 50% rate of production. There is ample pig iron accumulated for such an increase, and idle blast furnaces are not likely to be blown in, except in special instances, for some time. Steel prices are steadier than they were and in some lines may be regarded as quite firm.

Iron and steel exports are improving constantly. The October figures, just out, show 147,000 tons exported during the month, against 96,000 tons in September, 86,000 tons in August, 145,000 tons in July, and an average of 141,000 tons a month during the first six months of the year. Reports from steel manufacturers indicate that there has been a further increase since October.

**Pig Iron**—The American Steel Foundries has purchased 7500 tons of basic iron, at $12.75, delivered, figuring out $12.50 at furnace with some of the business, but somewhat lower prices as to the balance. There is a fair running demand for foundry iron, but nothing big, and quotations are unchanged: Bessemer, $13.75; basic, $12.50; No. 2 foundry, $12.75@13; malleable, $12.75@13; gray forge, $12.50@12.75, at Valley furnaces, 95c. higher delivered Pittsburgh.

**Ferromanganese**—The ferromanganese market remains quiet. Some consumers are apprehensive of further large advances, but are making no particular effort to cover. We quote prompt and contract at $68, Baltimore.

**Steel**—Negotiations are beginning on contracts for billets and sheet bars for next year's delivery. For early deliveries we quote billets at $18.50 and sheet bars at $19, at maker's mill, Pittsburgh or Youngstown. Rods are $24.50@25, Pittsburgh.

**IRON ORE**

Imports and Exports of Iron Ore in the United States 10 months ended, Oct. 31, in long tons:

| | 1913 | 1914 | Changes |
|---|---|---|---|
| Imports | 2,191,151 | 1,210,093 | D. 981,058 |
| Exports | 907,251 | 548,827 | D. 358,424 |

In 1914 the larger imports were 698,034 tons from Cuba; 275,953 from Sweden; 66,982 from Spain.

Imports of manganese ore for the 10 months were 288,188 tons in 1913, and 255,110 tons in 1914; decrease, 33,078 tons.

**COKE**

Coke production in the Connellsville region is reported by the "Courier" at 195,575 short tons; shipments, 196,157 tons. Production of Greenville and Upper Connellsville districts, 28,765 tons.

**Exports and Imports of Fuel** in the United States 10 months ended Oct. 31, in long tons:

| | Exports | | Imports | |
|---|---|---|---|---|
| | 1913 | 1914 | 1913 | 1914 |
| Anthracite | 3,598,343 | 3,406,491 | 864 | 19,295 |
| Bituminous | 15,543,656 | 12,254,757 | 1,136,737 | 1,088,608 |
| Coke | 711,818 | 511,207 | 67,297 | 93,936 |
| Bunker coal | 6,483,020 | 6,285,770 | ..... | ..... |
| Total | 26,336,837 | 22,458,225 | 1,204,898 | 1,201,839 |

The bunker coal, or coal furnished to steamships in foreign trade, is practically all bituminous. The greater part of the trade, both imports and exports, is with Canada.

# CHEMICALS

**NEW YORK—Dec. 16**

The general market continues slow and dull, with only a very moderate business doing.

**Arsenic**—Business continues quiet and unchanged. Current quotations remain at $3.75@4 per 100 lb. for both spot and futures.

**Copper Sulphate**—On a moderate business prices are unchanged at $4.35 per 100 lb. for carload lots and $4.60 per 100 lb. for smaller parcels.

**Nitrate of Soda**—Business is dull and sales small. Prices are nominally the same as by last report, 1.85c. per lb. for both spot and futures.

**Pyrites**—Imports at Baltimore for the past week included 3464 tons of pyrites from Huelva, Spain.

### Assessments

| Company | Delinq. | Sale | Amt. |
|---|---|---|---|
| Andes, Nev. | Jan. 5 | Jan. 27 | $0.03 |
| Atlantic, Ida. | Nov. 28 | Dec. 28 | 0.0005 |
| Beaver Copper, Utah. | Dec. 3 | Dec. 22 | 0.005 |
| Caledonia, Nev. | Dec. 8 | Dec. 31 | 0.05 |
| Century, Utah. | Jan. 2 | Feb. 2 | 0.01 |
| Clear Grit, Ida. | Jan. 12 | Jan. 29 | 0.0015 |
| Con. Imperial, Nev. | Dec. 23 | Jan. 15 | 0.01 |
| Con. Ores, Utah. | Dec. 4 | Dec. 20 | 0.25 |
| Crown Point, Nev. | Dec. 8 | Dec. 29 | 0.05 |
| Darby, Ida. | Dec. 14 | Jan. 14 | 0.001 |
| Dfd. Bk. Butte, Nev. | Dec. 1 | Dec. 30 | 0.01 |
| East Hercules, Ida. (post.) | Dec. 1 | Jan. 2 | 0.001 |
| Emerald, Utah (three instal.) | ..... | June 9 | 0.01 |
| Exchequer, Nev. | Dec. 21 | Jan. 11 | 0.03 |
| Gold Bond, Utah. | Nov. 24 | Dec. 24 | 0.001 |
| Grt. Copp. King, Utah. | Dec. 21 | Jan. 21 | 0.001 |
| Gypsy Qn., Nev. | Jan. 12 | Feb. 16 | 0.01 |
| Hale and Norcross, Nev. | Dec. 14 | Jan. 4 | 0.03 |
| Hilarity, Ida. (post.) | Oct. 12 | Dec. 23 | 0.003 |
| Hope, Calif. | Dec. 15 | Jan. 11 | 0.05 |
| Hypotheek, Ida. | Dec. 17 | Jan. 11 | 0.006 |
| Id.-Mont, Ida. (post.) | Nov. 2 | Jan. 8 | 0.001 |
| Lehi Tintic, Utah. | Dec. 17 | Jan. 16 | 0.0025 |
| Lynn Big Six, Utah. | Nov. 21 | Dec. 26 | 0.005 |
| Majestic-Idol, Nev. | Dec. 15 | Jul. 20 | 0.005 |
| Mammoth Gold, Nev. | Nov. 23 | Jan. 4 | 0.02 |
| Maxfield, Utah. | Dec. 9 | Dec. 30 | 0.0016 |
| New Yerington, Nev. | Dec. 23 | Jan. 13 | 0.01 |
| O. K. Silver, Utah. | Dec. 14 | Dec. 31 | 0.00167 |
| Oreano, Ida. | Dec. 26 | Jan. 25 | 0.00075 |
| Overman, Nev. | Dec. 22 | Jan. 11 | 0.05 |
| Phoenix, Ida. (post.) | Nov. 26 | Dec. 26 | 0.005 |
| Potosi, Nev. | Jan. 12 | Feb. 4 | 0.02 |
| Reindeer-Qn., Ida. (post.) | Sept. 21 | Dec. 26 | 0.002 |
| Rainbow, Ida. | Nov. 30 | Dec. 31 | 0.002 |
| Raven, Ida. | Dec. 30 | Jan. 30 | 0.0003 |
| Rexall, Utah. | Dec. 1 | Dec. 21 | 0.002 |
| Riverside, Ida. | Dec. 20 | Jan. 20 | 0.001 |
| St. Francis, Calif. | Dec. 8 | Dec. 28 | 0.0025 |
| Seg. Belcher, Nev. | Dec. 16 | Jan. 11 | 0.02 |
| Sheba, Utah. | Jan. 12 | Feb. 24 | 0.05 |
| Sonora, Ida. | Nov. 30 | Dec. 30 | 0.002 |
| Sunshine, Ida. | Nov. 23 | Dec. 22 | 0.001 |
| Syndicate, Ida. | Nov. 26 | Dec. 28 | 0.001 |
| Tarbox, Ida. (post.) | Nov. 25 | Dec. 28 | 0.0025 |
| Tuscumbia, Ida. (post.) | Nov. 20 | Dec. 21 | 0.002 |
| Umatilla, Nev. | Jan. 4 | Feb. 8 | 0.01 |
| Utah-Yerington, Nev. | Jan. 2 | Jan. 23 | 0.0006 |
| Utah Zinc, Utah. | Dec. 7 | Dec. 28 | 0.0025 |
| Wheeler, Utah. | Dec. 21 | Jan. 11 | 0.01 |
| Wisconsin, Ida. | Nov. 16 | Dec. 21 | 0.003 |
| Yankee Con, Utah. | Dec. 17 | Jan. 4 | 0.01 |
| Zuma, Utah. | Dec. 21 | Jan. 12 | 0.0025 |

### Monthly Average Prices of Metals

SILVER

| Month | New York | | | London | | |
|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1914 | 1912 | 1913 | 1914 |
| January | 56.260 | 62.938 | 57.572 | 25.887 | 28.983 | 26.553 |
| February | 59.043 | 61.642 | 57.506 | 27.190 | 28.357 | 26.573 |
| March | 58.375 | 57.870 | 58.067 | 26.875 | 26.669 | 26.788 |
| April | 59.207 | 59.490 | 58.519 | 28.284 | 27.416 | 26.958 |
| May | 60.880 | 60.361 | 58.175 | 28.038 | 27.825 | 26.704 |
| June | 61.290 | 58.990 | 56.471 | 28.215 | 27.199 | 25.948 |
| July | 60.654 | 58.721 | 54.678 | 27.919 | 27.074 | 25.219 |
| August | 61.606 | 59.293 | 54.344 | 28.375 | 27.335 | 25.979 |
| September | 63.078 | 60.640 | 53.290 | 29.088 | 27.986 | 24.260 |
| October | 63 471 | 60.793 | 50.654 | 29.299 | 28.083 | 23.199 |
| November | 62.792 | 58.995 | 49.082 | 29.012 | 27.263 | 22.703 |
| December | 63.365 | 57.760 | ..... | 29.320 | 26.720 | ..... |
| Year | 60.835 | 59.791 | ..... | 28.042 | 27.576 | ..... |

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

| Month | New York | | London | | | |
|---|---|---|---|---|---|---|
| | Electrolytic | | Standard | | Best Selected | |
| | 1913 | 1914 | 1913 | 1914 | 1913 | 1914 |
| January | 16.488 | 14.223 | 71.741 | 64.304 | 77.750 | 69.488 |
| February | 14.971 | 14.491 | 65.519 | 65.259 | 71.575 | 70.188 |
| March | 14.713 | 14.131 | 65.329 | 64.276 | 70.658 | 69.170 |
| April | 15.291 | 14.211 | 68.111 | 64.747 | 74.273 | 69.313 |
| May | 15.436 | 13.996 | 68.807 | 63.182 | 74.774 | 67.786 |
| June | 14.672 | 13.603 | 67.140 | 61.336 | 70.821 | 66.274 |
| July | 14.190 | 13.223 | 64.166 | 60.540 | 69.446 | 64.955 |
| August | 15.400 | * | 69.200 | ‡ | 74.313 | ‡ |
| September | 16.328 | * | 73.125 | ‡ | 78.614 | ‡ |
| October | 16.337 | * | 73.383 | ‡ | 79.250 | ‡ |
| November | 15.182 | 11.739 | 68.275 | 53.227 | 73.825 | * |
| December | 14.224 | ..... | 65.223 | ..... | 69.583 | ..... |
| Year | 15.269 | ..... | 68.335 | ..... | 73.740 | ..... |

New York, cents per pound, London, pounds sterling per long ton. *Not reported. ‡London Exchange closed.

The usual pig-iron price averages are omitted for lack of space this week, but the omission is not permanent.

TIN

| Month | New York | | London | |
|---|---|---|---|---|
| | 1913 | 1914 | 1913 | 1913 |
| January | 50.298 | 37.779 | 238.273 | 171.905 |
| February | 48.766 | 39.830 | 220.140 | 181.556 |
| March | 46.832 | 38.038 | 213.615 | 173.619 |
| April | 49.115 | 36.154 | 224.159 | 163.963 |
| May | 49.038 | 33.360 | 224.143 | 150.702 |
| June | 44.820 | 30.577 | 207.208 | 138.321 |
| July | 40.260 | 31.707 | 183.511 | 142.517 |
| August | 41.582 | * | 188.731 | ‡ |
| September | 42.410 | 32.675 | 193.074 | ‡ |
| October | 40.462 | 30.284 | 184.837 | ‡ |
| November | 39.810 | 33.304 | 180.869 | 139.391 |
| December | 37.635 | ..... | 171.786 | ..... |
| Av. year | 44.252 | ..... | 206.279 | ..... |

New York in cents per pound; London in pounds sterling per long ton.

LEAD

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1913 | 1914 | 1913 | 1914 | 1913 | 1914 |
| January | 4.321 | 4.111 | 4.171 | 4.011 | 17.114 | 19.665 |
| February | 4.325 | 4.048 | 4.175 | 3.937 | 16.550 | 19.606 |
| March | 4.327 | 3.970 | 4.177 | 3.850 | 15.977 | 19.651 |
| April | 4.381 | 3.810 | 4.242 | 3.688 | 17.597 | 18.225 |
| May | 4.342 | 3.900 | 4.226 | 3.808 | 18.923 | 18.503 |
| June | 4.325 | 3.900 | 4.190 | 3.810 | 20.226 | 19.411 |
| July | 4.353 | 3.891 | 4.223 | 3.738 | 20.038 | 19.051 |
| August | 4.624 | 3.875 | 4.550 | 3.715 | 20.406 | ‡ |
| September | 4.698 | 3.828 | 4.579 | 3.658 | 20.648 | ‡ |
| October | 4.402 | 3.528 | 4.253 | 3.384 | 20.302 | ‡ |
| November | 4.293 | 3.683 | 4.146 | 3.585 | 19.334 | 18.500 |
| December | 4.047 | ..... | 3.929 | ..... | 17.798 | ..... |
| Year | 4.370 | ..... | 4.238 | ..... | 18.743 | ..... |

New York and St. Louis cents per pound. London, pounds sterling per long ton.

SPELTER

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1913 | 1914 | 1913 | 1914 | 1913 | 1914 |
| January | 6.931 | 5.262 | 6.854 | 5.112 | 26.114 | 21.533 |
| February | 6.239 | 5.377 | 6.089 | 5.228 | 25.338 | 21.413 |
| March | 6.078 | 5.250 | 5.926 | 5.100 | 24.605 | 21.460 |
| April | 5.641 | 5.113 | 5.491 | 4.963 | 25.313 | 21.569 |
| May | 5.406 | 5.074 | 5.256 | 4.924 | 24.583 | 21.393 |
| June | 5.124 | 5.000 | 4.974 | 4.850 | 22.143 | 21.345 |
| July | 5.278 | 4.920 | 5.128 | 4.770 | 20.592 | 21.568 |
| August | 5.658 | 5.568 | 5.508 | 5.418 | 20.706 | ‡ |
| September | 5.694 | 5.380 | 5.544 | 5.230 | 21.148 | ‡ |
| October | 5.340 | 4.909 | 5.188 | 4.750 | 20.614 | ‡ |
| November | 5.229 | 5.112 | 5.083 | 4.962 | 20.581 | 25.016 |
| December | 5.156 | ..... | 5.004 | ..... | 21.214 | ..... |
| Year | 5.648 | ..... | 5.504 | ..... | 22.746 | ..... |

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

## STOCK QUOTATIONS

COLO. SPRINGS Dec. 14

| Name of Comp. | Bid. |
|---|---|
| Acacia | .03 |
| Crippie Cr'k Con | .007 |
| C. K. & N. | .05½ |
| Doctor Jack Pot | .07½ |
| Elkton Con. | .41½ |
| El Paso | 1.35 |
| Findlay | .01½ |
| Gold Dollar | .03½ |
| Gold Sovereign | .02½ |
| Isabella | .11½ |
| Jack Pot | .06 |
| Jennie Sample | .02 |
| Jerry Johnson | .03 |
| Lexington | ‡.003 |
| Old Gold | .007 |
| Mary McKinney | .40 |
| Pharmacist | ‡.003 |
| Portland | 1.10 |
| Raven B. H. | .03½ |
| Vindicator | 1.15 |

SALT LAKE Dec. 11

| Name of Comp. | Bid. |
|---|---|
| Beck Tunnel | .04½ |
| Black Jack | .04 |
| Colorado Mining | .10½ |
| Crown Point | ‡.01 |
| Daly-Judge | 4.60 |
| Gold Chain | ‡.10 |
| Grand Central | .61 |
| Iron Blossom | 1.10 |
| Little Bell | .10 |
| Lower Mammoth | .01¼ |
| Mason Valley | ‡.50 |
| May Day | .11 |
| Opohongo | ‡.01¼ |
| Prince Con. | .18 |
| Silver King Coal'n | 2.40 |
| Silver King Con. | 1.72½ |
| Sioux Con. | .02 |
| Uncle Sam | .04 |
| Utah Con. | .00½ |
| Yankee | .01 |

TORONTO Dec. 14

| Name of Comp. | Bid. | Name of Comp. | Bid. |
|---|---|---|---|
| Bailey | .01½ | Foley O'Brien | .18 |
| City of Cobalt | .30 | Hollinger | 19.25 |
| Coniagas | 5.50 | Imperial | .01 |
| Peterson Lake | .27 | Jupiter | .10 |
| Right of Way | .03 | McIntyre | .22 |
| T. & Hudson Bay | 30.00 | Pearl Lake | .03 |
| Timiskaming | .11 | Porcu. Gold | .05 |
| Wettlaufer-Lor. | .05 | Preston E. D. | .01 |
| Big Dome | 8.25 | Rea | .15 |
| Dome Exten. | .08½ | Seneca Superior | 1.75 |

SAN FRANCISCO Dec. 14

| Name of Comp. | Bid. | Name of Comp. | Bid. |
|---|---|---|---|
| Comstock Stocks | | Misc. Nev. & Cal. | |
| Alta | ‡.05 | Belmont | 5.00 |
| Belcher | ‡.75 | Jim Butler | .80 |
| Best & Belcher | .04 | Lone Star | .09 |
| Caledonia | .30 | MacNamara | .01 |
| Challenge Con. | .12 | Midway | .09 |
| Confidence | ‡.21 | Mont.-Tonopah | .37 |
| Con. Virginia | .11 | North Star | .19 |
| Crown Point (Nev.) | ‡.40 | Rescue Eula | .07 |
| Gould & Curry | .02 | West End Con. | .64 |
| Hale & Norcross | .04 | Atlanta | .44 |
| Julia | .01 | Booth | .15 |
| Mexican | .29 | C.O.D. Con. | .09 |
| Occidental | .85 | Comb. Frac. | .10 |
| Ophir | .09 | Jumbo Extension | 2.65 |
| Overman | .08 | Pitts.-Silver Peak | .17 |
| Potosi | ‡.01 | Round Mountain | .39 |
| Savage | .04 | Sandstorm Kendall | .13½ |
| Sierra Nevada | .04 | Silver Pick | .14 |
| Union Con. | .06 | Central Eureka | ‡.25 |
| Yellow Jacket | ‡.40 | So. Eureka | ‡1.80 |

N. Y. EXCH. Dec. 14

| Name of Comp. | Clg. |
|---|---|
| Amalgamated | 56⅜ |
| Am.Sm.&Ref.,com | 60⅜ |
| Am. Sm. & Ref., pf. | 100⅛ |
| Am. Sm. Sec., pf. B | ‡78 |
| Anaconda | 29½ |
| Batopilas Min. | ‡.75 |
| Bethlehem Steel, pf. | 87⅛ |
| Chino | 36 |
| Colo. Fuel & Iron | 25 |
| Federal M. & S., pf. | 29 |
| Great Nor., ore., ctf. | 28 |
| Guggen. Exp. | 47⅞ |
| Homestake | ‡110 |
| Inspiration Con. | 17⅛ |
| Mex. Petroleum | 53 |
| Miami Copper | 18⅛ |
| Nat'l Lead, com. | 42⅛ |
| National Lead, pf. | 103⅛ |
| Nev. Consol. | 13½ |
| Ontario Min. | ‡2⅛ |
| Phelps Dodge | ‡175 |
| Quicksilver, pf. | 1½ |
| Ray Con. | 17⅛ |
| Republic I&S, com. | 20 |
| Republic I&S, pf. | 77½ |
| SlossSheffi'd, com. | 21⅛ |
| Sloss Sheffield, pf. | ‡82 |
| Tennessee Copper | 33⅛ |
| Utah Copper | 50⅛ |
| U. S. Steel, com. | 54⅛ |
| U. S. Steel, pf. | 104⅛ |

N. Y. CURB Dec. 14

| Name of Comp. | Clg. |
|---|---|
| Beaver Con. | .19 |
| Big Four | .07 |
| Blue Bell | .06½ |
| Braden Copper | 6⅜ |
| B. C. Copper | .50 |
| Buffalo Mines | ⅞ |
| Can. Cop. Corpn | 1⅛ |
| Can. G. & S. | .05 |
| Caribou | .66 |
| Chambers Ferland | .13 |
| Con. Ariz. Sm. | 7/16 |
| Coppermines Cons. | 1⅛ |
| Davis-Daly | .75 |
| Diam'field-Daisy | .09 |
| Dia. Black B. | .07 |
| Ely Con. | ‡.01 |
| Florence | .70 |
| Goldfield Con. | 1 9/16 |
| Goldfield Merger | .41 |
| Greene Cananea | 28 |
| Kerr Lake | 4⅛ |
| La Rose | ⅞ |
| McKinley-Dar-Sa | .56 |
| Mines of Am. | 2⅛ |
| Mutual Min., pf. | ‡2½ |
| Nevada Hills | .30 |
| New Utah Bingham | 7/16 |
| Nipissing Mines | 5⅛ |
| Ohio Copper | .11 |
| Oro | .17 |
| Pacific Smelt | ⅛ |
| Stand'd Oil of N.J. | 405 |
| Standard S. L. | 1⅛ |
| Stewart | 1 11/16 |
| Tonopah | 7⅛ |
| Tonopah Ex. | 2 11/16 |
| Tonopah Merger | .43 |
| Tularosa | 5/16 |
| West End Ex. | .03 |
| Yukon Gold | 2⅛ |

LONDON Dec. 1

| Name of Comp. | Clg. |
|---|---|
| Alaska Tre'dwell | £8 2s 6d |
| Camp Bird | 0 6 0 |
| El Oro | 0 11 0 |
| Esperanza | 0 8 3 |
| Mexico Mines | 4 0 0 |
| Oroville | 0 7 0 |
| Santa Gert'dis | 0 10 0 |
| Tomboy | 1 1 10½ |

BOSTON EXCH Dec. 14

| Name of Comp. | Clg. |
|---|---|
| Adventure | 1 |
| Ahmeek | 255 |
| Alaska Gold M. | 25⅜ |
| Algomah | ‡.90 |
| Allouez | 37 |
| Am. Zinc | 17⅛ |
| Ariz. Com., ctfs. | 4 1/16 |
| Bonanza | ‡.51 |
| Butte-Balaklava | ‡2 |
| Butte & Superior | ‡25 |
| Calumet & Ariz. | 57⅛ |
| Calumet & Hecla | 380 |
| Centennial | 15 |
| Cliff | ‡1 |
| Copper Range | 31⅛ |
| Daly West | ‡2 |
| East Butte | 8⅛ |
| Franklin | 5⅛ |
| Granby | 66 |
| Hancock | 16 |
| Helvetia | ‡.30 |
| Indiana | 3⅛ |
| Island Cr'k, com. | ‡46 |
| Island Cr'k, pfd. | ‡87 |
| Isle Royale | 19 |
| Keweenaw | ‡3⅛ |
| Lake | 6⅛ |
| La Salle | ‡3⅛ |
| Mass | 4 |
| Mayflower | 5⅛ |
| Michigan | ‡.60 |
| Mohawk | 45 |
| New Arcadian | 6⅛ |
| New Idria Quick | ‡3⅛ |
| North Butte | 22⅛ |
| North Lake | 1⅛ |
| Ojibway | ‡.90 |
| Old Colony | 4⅛ |
| Old Dominion | 45⅛ |
| Osceola | 68 |
| Quincy | 52⅛ |
| Santa Fe | ‡1⅛ |
| Shannon | 4⅛ |
| Shattuck-Ariz. | 20⅛ |
| Superior | 26⅛ |
| Superior & Bost. | 1⅛ |
| Tamarack | 29 |
| Trinity | 3⅛ |
| Tuolumne | ‡.35 |
| U. S. Smelting | 30 |
| U. S. Smelt'g, pf. | 43⅛ |
| Utah Apex | 2⅛ |
| Utah Con. | 10⅛ |
| Victoria | ‡1 |
| Winona | 2 |
| Wolverine | 37 |
| Wyandot | .37 |

BOSTON CURB Dec. 14

| Name of Comp. | Bid. |
|---|---|
| Alvarado | .65 |
| Bingham Mines | ‡4.04⅛ |
| Boston Ely | .22 |
| Butte & Lon'n Dev. | .22 |
| Calaveras | .93 |
| Calumet-Corbin | .08 |
| Chief Con. | .75 |
| Corbin | ‡.90 |
| Cortez | .15 |
| Crown Reserve | .74 |
| Eagle & Blue Bell | .90 |
| First Nat. Cop. | 1 1/16 |
| Houghton Copper | 2 |
| Iron Cap Cop., pf. | ‡5 |
| Majestic | .17 |
| Mexican Metals | .16 |
| Nevada-Douglas | .50 |
| New Baltic | 1⅛ |
| Oneco | .70 |
| Raven Copper | .10 |
| Smokey Dev. | .25 |
| So. Lake | .05 |
| Tonopah Victor | ‡.29 |
| Trethewey | .15 |
| United Verde Ext. | 1 1/16 |

‡Last Quotations.