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Practical Blast-furnace Management

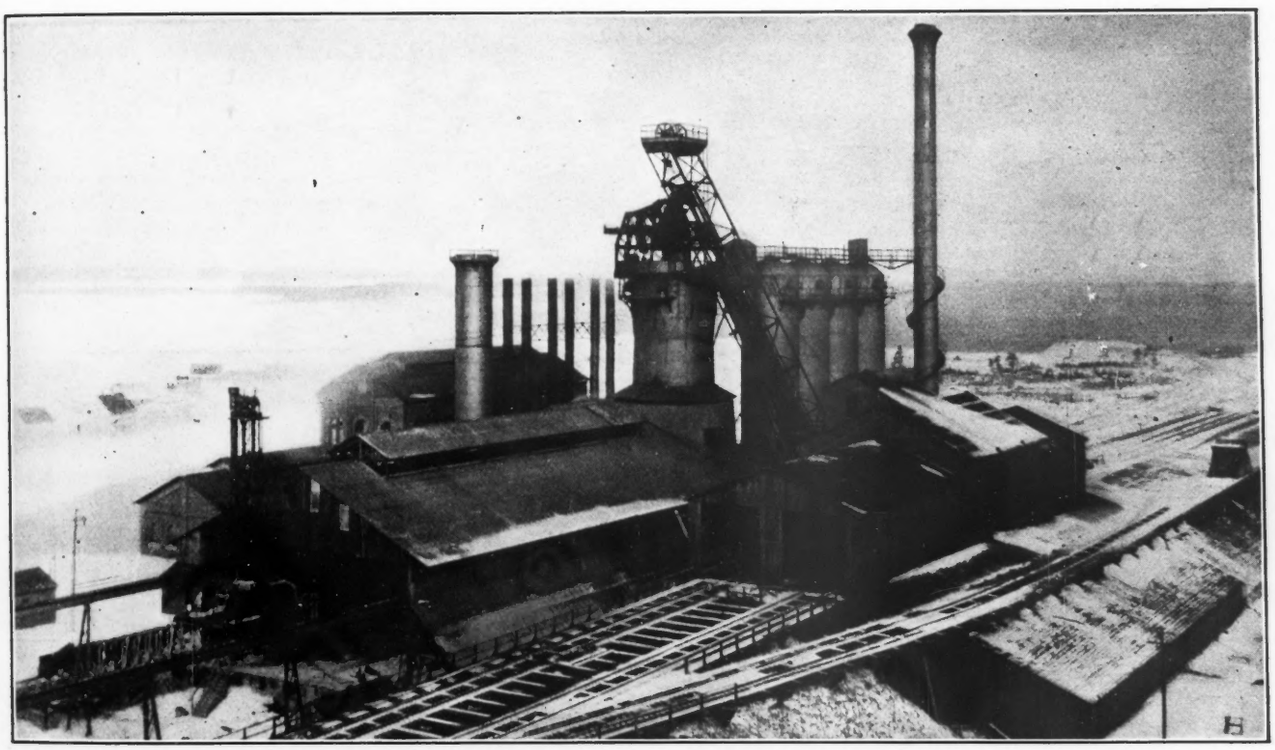
Mechanical Improvements Have Relieved the Superintendent of Many Worries, Leaving Him to Devote His Energies to Scientific Metallurgy

BY RANDOLPH BOLLING*

Although the actual management of modern blast furnaces differs only slightly from the methods in vogue a decade ago, still the work of the superintendent is much less exacting. Furnace managers at modern furnaces are relieved of more than half the worry and the delays that were encountered before the invention of the skip-hoist, the electric stock-car, the metal blowing-tub valve, the Uehling recording pyrometer, the hot-metal car, the pig breaker, the Vaughn mud gun and other ingenious inventions. Blast-furnace work nowadays is a pleasure in comparison with the nightmare of the old days when the old vertical elevators would insist upon breaking down just at the critical moment, and the two "darkys" on top would come down in trying moments with ash-colored faces to tell "de boss" that the furnace was hanging.

The old method of hand-charging is mercifully no longer in general use; the clumsy "iron buggy" was a barbarous form of dump cart for men to haul, loaded with 1000 lb. of ore or limestone, over rough stock-house floors on rainy and snowy nights; sometimes the run would be more than 800 ft. from ore pile to elevator. The old form of blowing engine was a very cranky machine to deal with. The leather valves would burn out under high pressure, or the engine would be so poorly designed that it would suck all the steam pressure out of the boiler, giving the coal pile quick action. Then the old-fashioned spring pyrometer, that required a stove tender of iron nerve to lift up the caps to the blowpipes and count 20 while he was the recipient of hot air, dust, and noise, was decidedly inaccurate even after the most conscientious performance of duty. All these things and the utter dependence on a large body of skilled men who were all likely to lay off on a pay night or holiday did not tend to put the blast-furnace management in the easy-job category.

Now we have the tables turned. We need only a handful of men; we can put our hands on a few electric controllers and pull the levers, and the filling proceeds automatically. As far as the engine room is concerned the machines are now so well made that we never give them a thought except, perhaps, to slow down a trifle or to speed up as conditions may require. We lose no sleep about the cast-house crew's getting the last cast out of the way; for the metal is now dumped into a big ladle or hot-metal car, and the iron drops off the end of a casting machine. The cinder car that would always get in the "off the track" state, or break a wheel flange, has also lost its terrors; the granulator can do its work while the dump sleeps in peace.



BLAST-FURNACE PLANT WITH MODERN EQUIPMENT

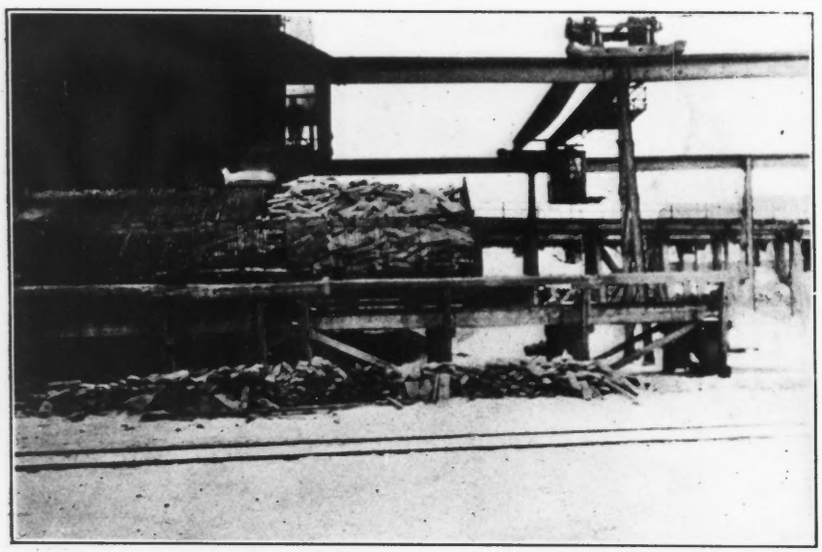
The Day of the Metallurgical Chemist

So we have triumphed over our old mechanical enemies and can turn our attention to pure metallurgy. The laboratory now has a chance to come into its

*Consulting metallurgist, Nova Scotia Steel and Coal Company, Sydney Mines, N. S.

own. Perhaps the reason why the chemist did not more frequently become manager in the old days was because he was not a pipefitter, buggy puller, or iron carrier; in those good old sledging, pulling, hauling and bellowing days, the refined college man with metallurgical training was not at his best at a break-down scene; the man of the hour was the blacksmith, or the labor boss wore the hero's medal. Just as the ox-cart gave way to the automobile so has the non-technical blast-furnace man been superseded by the metallurgist. This change has been gradual, but economic conditions forced it. When automatic machinery was installed at the furnace it brought to an end the reign of brute force and gave some chance for reason and science. The old fellows, deprived of the bar and sledge, had nothing to do but sit and smoke, and watch the pyrometer and the gages.

In order that the metallurgical manager may concentrate his mind fully on the furnace he must have organized a good staff of assistants who understand their business, and he must not be bothered by little worrying furnace details.



PIG-CASTING MACHINE AND CRANE FOR HANDLING SAND IRON

Chemical Laboratory

The analytical department should be well equipped. First of all, a substantial concrete or brick building should be set aside entirely for chemical work. It should be a roomy and well lighted building. It should also contain some creature comforts, good desks and chairs in the chief chemist's office, cloak room, toilet room, etc., like a well arranged office building. On the ground floor a 5-h.p. motor should be provided to drive ore crushers, ball mills, agate mortars, power drills, etc.

The sampling department of a laboratory should be equipped to handle by power large samples of ore, limestone and coke. It is a good investment in the end; and nothing stimulates the workers in the laboratory more than the knowledge that the sampling is done along large and systematic lines. The laboratory operating rooms and offices should be situated on the second floor. White porcelain sinks and soapstone slabs for working tables are more lasting and satisfactory than steel or wood. The woodwork should be of hardwood, and all gas, air, and steam cocks should be heavily nickeled. Hoods built of soapstone slabs with exhaust fans at the top should be employed to carry off corrosive fumes and keep the atmosphere free from contamination. Special rooms for determinations likely to be affected by stray fumes should be provided, also electric heaters placed conveniently, and gas suction and pressure cocks at each table.

The balance room should contain a good equipment of analytical balances and weights. The balances should be carried on brick piers and should not be in contact with the floor. This prevents interference by vibrations from passing locomotives. Heavy chemicals should be stored in a special acid room in the basement and transferred to reagent bottles as required. A stock room should be provided on the second floor for glass apparatus.

The management of the laboratory should be given to a man of thorough training in physics, analytical and applied chemistry, one who takes up the work with enthusiasm and strives to distinguish himself in the profession.

Analyses should be reported directly by telephone to the manager's burden clerk and the results should be tabulated on wall charts, so that records for a year plotted on profile paper are carried along for each determination. The records for each day's run from the pyrometer, and steam-blast gages are carried in like manner, as are also the number and weight of charges. The weight of each material in the burden is written on a blackboard. A window in the manager's office should command a view of the cinder notch, so that each flush of cinder can be noted by an assistant. Cabinets for samples of each flush of cinder and test pieces of pig iron should be provided.

Assembling Material

The greatest care should be exercised in stocking ores, fluxes and coke. Each ore must be kept absolutely separate, and in case the furnace is supplied with only one kind of ore, samples are to be taken from each car and the ore segregated in different piles with reference to its proportion of silica and metallic iron. If any variation greater than 0.50 per cent. silica is noted in individual car lots of limestone, the lots should also be kept in separate bins or piles. The same rule applies to coke; soft, friable coke and hard, well burnt coke are to be kept separate. The ash should be determined on each carload of coke, and if any wide variation is noted, a segregation of high-ash and low-ash cokes should also be made.

The general scheme for stockhouse supervision should be such that the location and average chemical composition of each grade of material can be accurately known, and charts should be mapped out, giving this information clearly, so that the stockhouse foreman may have a thorough knowledge regarding the stock under his charge. At furnaces employing an ore mixture composed of a dozen different kinds of ore, varying from 38 to 3 per cent. silica, and using both dolomite and limestone as fluxes, any confusion of orders regarding the filling will be likely to produce disastrous consequences.

Blowing In

The old practice of blowing in the furnace was to use about 15 cords of wood, arranged in a sort of platform in the hearth. Later it was discovered that this amount of wood was excessive. The present practice is to spread a layer of coke breeze at least 2 ft. thick on the bottom; the object of this is to keep the first iron from chilling on the cold bottom and also to prevent the tap hole from filling with chilled iron. Solid coke is now charged until the surface rises to the cooler ports in the bosh. Radiating from the center of the furnace to each port a line of kindling wood is laid like spokes in a wheel; a couple of feet of wood is placed upon this and then 20 or 30 sacks of charcoal upon the wood. Coke is lowered carefully down upon this bed of fuel until several feet have accumulated. The furnace can now be filled with the skip, as usual, until the coke is level with the mantel plate.

Calculating the Burden

The first consideration in calculating a charge is the grade of iron the furnace is to make, whether basic, foundry, malleable, special high-silicon, bessemer, or

low-phosphorus. It is by charging the ores, limestone and coke in certain predetermined "rounds" or charges that a definite chemical composition of the metal tapped is secured, together with the continuous operation of the furnace. We may assume in beginning our calculations that the following analyses represent the average composition of the materials assembled.

COMPOSITION OF MATERIALS.

	Coke.	Iron Ore.	Dolomite.
	Per Cent.	Per Cent.	Per Cent.
SiO_2	3.35	20.0	6.0
Al_2O_3	2.73	3.20	1.15
CaO	0.10	3.10	30.0
MgO	0.10	2.60	19.0
Fe_2O_3	....	70.0	.....
Fe	....	50.0	....
Mn_3O_4	....	0.20	.....
P_2O_5	....	1.05	.....
SO_3	....	0.10	.....
CO_2	....	.....	44.0

Suppose the slag required to be one having about the fusibility of a sesquibasic slag; that is, of a slag in which the oxygen ratio is four to three. In the accompanying table of slag types it appears that for this type one part of lime saturates 0.714 parts silica, or one part of silica requires 1.4 parts lime. After choosing any proper amount of coke per ton of ore melted (0.75 ton is in most cases sufficient), all the data necessary for the calculation are at hand.

TYPES OF BLAST FURNACE SLAGS.

Composition.	Acid.	Sesqui-acid.	Neutral.	Sesqui-basic.	Bi-basic.	Tri-basic.	Quadri-basic.
SiO_2 (per cent.)	68.19	61.65	51.72	41.66	34.88	26.30	21.13
CaO (per cent.)	31.81	38.35	48.28	58.34	65.12	73.70	78.87
O of SiO_2 : O of bases	4:1	3:1	2:1	4:3	1:1	2:3	1:2
1 part CaO saturates SiO_2	2.143	1.6071	1.0713	0.714	0.538	0.357	0.268
1 part SiO_2 saturates CaO	0.466	0.622	0.932	1.400	1.858	2.829	3.732

In order to determine the quantity of lime required to flux the entire charge, it is convenient to begin by finding the equivalents in silica and lime for the elements in each material in the burden.

The iron ore contains 20 per cent. silica, but the alumina, lime, magnesia and manganese oxide present have a total fluxing power equivalent to 12.1 per cent. lime. In the same way the slagging equivalents in the dolomite used as flux are 6 per cent. silica and 58.47 per cent. lime; and those of coke 3.35 per cent. silica and 4.69 per cent. lime. Since the calculation is made upon a basis of iron ore, and since only 75 per cent. coke is required the equivalents for coke will be only three-fourths of those found, or 2.52 tons silica and 3.52 tons lime per 100 tons ore.

Combining the equivalents of the iron ore and the coke required to smelt it, gives 22.52 tons silica and 15.63 tons lime per 100 tons ore. Since in the desired slag one ton of lime satisfies 0.714 tons silica, the lime equivalent in the ore and coke will satisfy $22.52 - (15.63 \times 0.714) = 11.16$ tons of the silica in those materials, leaving $22.52 - 11.16 = 11.36$ tons silica to be saturated with the flux, which in this case is dolomite.

The silica in the dolomite will itself require $6 \times 1.40 = 8.40$ per cent. lime equivalent, leaving $58.47 - 8.40 = 50.07$ per cent. for fluxing purposes.

The ore and its coke contain 11.36 tons silica unsatisfied by the fluxing elements in those materials per 100 tons ore. This will require $11.36 \times 1.40 = 15.91$ tons lime equivalent, and to supply this equivalent will require $15.91 \div 50.07 = 0.317$ ton of dolomite per ton of ore.

The charges are, therefore, made up in the proportions of one ton iron ore, 0.75 ton coke and 0.317 ton dolomite; and since the ore contains 50 per cent. iron, the furnace will consume two tons of ore, 1.5 tons coke and 0.634 ton dolomite per ton of pig iron made.

The slag will contain all the elements in the charge which have been calculated as lime and silica equivalents. The ore and coke introduce silica equivalent to 22.53 per cent. and the dolomite 1.90 per cent., or a total of 24.43 per cent. of the ore charged. The total lime equals an equivalent of $15.63 + 18.59 = 34.22$ per cent. of the weight of ore charged. Converting these quantities in percentages of the total charge gives 41.66 per cent. silica and 58.34 per cent. lime.

In modern blast-furnace practice iron ore is usually fed in five-ton charges and coke and limestone in proportion. The first cast of iron is usually rather high in sulphur.

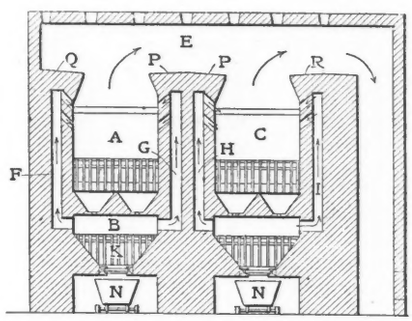
The temperature of the slag may be judged closely by the color when cold. If the furnace is hot the cold slag is white or bluish; when the furnace is not so hot the slag will be gray. A jet-black slag is the danger signal. It signifies either that water is leaking into the stack from some cooling block, or that the furnace is overburdened and that some ore and flux should be taken off the charge.

According to *The Mining Journal*, April 4, 1908, the returns of the Mining Bureau place the total value of the mineral production of Japan during 1907 at 104,270,771 yen, coal heading the list, while copper and petroleum come next in order. The figures stand as follows: Coal, 63,364,128 yen; copper, 26,302,204 yen; petroleum, 3,840,430 yen; gold, 3,795,772 yen; silver, 3,237,765 yen; iron, 2,195,595 yen; sulphur, 612,461 yen; other minerals, 920,416 yen, the total standing at 104,270,771 yen.

The Chatillon Process of Antimony Smelting

In French patent, No. 382,504, of Oct. 3, 1907, E. Chatillon, describes a furnace which is said to render it possible to treat finely divided antimony ores, and to obtain directly metallic antimony, or antimony oxides. It consists essentially of two cupola furnaces, *A* and *C*, placed side by side, and having a common crown *E*. Below each chamber is placed a smaller chamber *K*, into which cinders and gangue from the main chambers are allowed to drop from time to time. The air necessary for combustion passes through these lower chambers, entering the main chambers through the flues, *F G H I*, while the cooled cinders fall from time to time into trucks *N N*, placed below the furnace.

Alternate layers of fuel and ore are charged onto the grills placed in the main chambers; very finely divided ores are charged onto the projections, *P Q R*, at the top of the furnace, which serve as auxiliary hearths. The products of combustion, carrying antimonial vapors, leave



CHATTILON FURNACE FOR ANTIMONY ORES

the furnace as shown by the arrows, and are conducted through a number of hearth furnaces containing antimony sulphide, with which they react to give the desired compound; or they may be used to heat crucibles containing antimony ores, etc. The gases are then cooled by passing through a chamber containing vessels of running water. Finally the gases pass through other chambers containing bags filled with cotton, etc., in which they deposit antimony fumes.

The dimensions of many of the orebodies of Leadville were immense. The Evening Star-Maid of Erin ore shoot was in many places 30 ft. thick and 200 ft., or more, in width. The ore shoot extending through the Stone, Minnie, Col. Sellers and Moyer mines was 400 ft. wide in the Minnie and nearly 70 ft. thick.

The Cœur d'Alene mining district covers both slopes of the Bitter Root mountains, being partly in Montana and partly in Idaho.

Ore Contracts from a Producer's Point of View

How Ore Contracts Are Made. Treatment Charges. Benefit of Competition. Some Actual Examples and the Results Worked out

BY HENRY M. ADKINSON*

What is the mystery about the smelting process, and the making of contracts between miner and smelter, that results in the extraordinary secretiveness shown by the miner when questioned as to the terms of his contract with the smelter? We often read in the editorial columns of journals devoted to the mining industry, scathing criticisms of the policy of companies and managers which excludes other engineers from casual inspection of mines; of their hesitation or downright refusal to show to others of the profession the various favorable devices and details they have hit upon to aid their work; but we have never seen any comment whatsoever on the secrecy, with which they guard every detail touching upon the marketing of their ore. Managers are often ready to discuss the details of their work in the mines, but, from some esoteric reason perhaps, though probably from custom long established, if one of them ventures to ask another about the details of the contract for his product the inquiry is received in stony silence. Why is it?

How Ore Contracts are Made

What is the inherent quality of ore contracts which forbids their discussion? We all know what the ultimate value, the New York price of our metals is; why should we not know what proportion of that value the producer receives and hence have some data as to the proportion of profit which goes to the smelter? If producers will show a little less hesitation in telling one another these details the profit of the exchange will be considerable.

But what is our attitude? We go to the office of the smelter with as forlorn a hope as if we ventured into the labyrinth of the minotaur, lacking the Ariadnean thread to bring us safely out. We humbly beseech the monster to grant us livable terms; we wait in the anteroom, and at last we are presented with a document setting forth what we may have. With this document hugged to our bosom we go away, either leaping joyfully in our foolish belief that we have succeeded in getting more than Someone Else—that subjective competitor whom we ever strive to vanquish—or we walk with dragging footstep, feeling that Someone Else has received more than our portion, and we utterly ignore the practical step of confirming our success or failure in the light of the experience of our fellow producers.

And why is this the popular attitude? The state of mind of the average ore-seller is very simple. In an incredible number of cases he signs the contract offered him without carefully analyzing it. He neglects the simple precaution of figuring some of the former settlements on the basis of the new contract, *before* he signs it; a precaution which will promptly indicate whether or not the new contract will be an improvement on the old. He does not study the metal deductions, rate of payments, and treatment charges in their relation to the gross value of the ore in some of his typical shipments, in order to learn the percentage of division of that gross value between the smelter and himself. He is often ignorant of the details of the contract form, and will sign what is offered him rather than make tacit admission of his ignorance by asking the smelter representative to explain the terms to him. I know of one manager who was offered contracts by competing smelting companies. The first offered to pay him for 95 per cent. of the silver contents at 95 per cent. of the New York price; the second company offered payment for 95 per cent. of the contents at the New York price; and he failed to see any difference in the two items until a hypothetical case was figured out for him.

The state of mind of the ore-buyer is equally simple. He knows his business, and before presenting contract terms he talks with his man in a general way and finds out how much his opponent knows. Then he weaves around his unsuspecting victim his intricate web of percentages, deductions, treatment charges, and confusing legal verbiage, until to the proffered contract, more often than not, there is neither objection nor even protest made. He is not required by any rules of business conduct to show his opponent either the fine points, or even the obvious ones, and the seller is too proud of his own ability to admit ignorance. There are engineers and managers who show in every word that they are thoroughly alive to the importance of reducing the cost of their product; whose every thought is for economy in their mining, for saving in their milling operations, and who breathe, eat, and dream mining, milling, and transportation details; but who are confused, and apparently routed, by the mysterious details of selling their output. What would be our opinion of a storekeeper who worked incessantly to reduce his costs of rent, help, equipment and insurance; who was a close buyer and a good judge of necessary stock, and yet did not figure what was to be his market price on each item of the material he handled; but, who adopted the practice of allowing his customers themselves to name the price on the goods they bought?

I freely grant that in many cases there is an absolute monopoly of the smelting business, and the ore-seller has to take what he can get, but I also believe that in very many cases the ore-seller could obtain much better terms for his product if he demonstrated to the satisfaction of the ore-buyer that he knew his business, and that there would probably be some publicity started unless he obtained more of the "square deal" than was offered him.

Necessity of Definite Information

So the result is that just now we have the daily press teeming with allegations of the monopolistic power of the smelters, and the American Mining Congress hurling its semi-official charges against the "trust." But what has been brought forward which has the slightest definite information on any one point at issue between the ore producers and smelters? For one, I have failed to see anything. Everything has been of the nature so aptly described by my old professor in geology, as "perfectly true, perfectly general, and perfectly valueless." If there are really any grounds for these accusations it would seem that the only satisfactory method for setting them forth clearly would be to bring forward some exact data on the subject.

It is to help solve the problem along some such line, and to present both sides of the question fairly, that the following figures have been assembled and are given herewith. These statistics have been arranged to show at a glance, in what proportion the smelter has divided the total value of the output with the producer, and to enable us to scrutinize this result with an eye to the fairness of the division. The smelter returns in the following tables are on lead ore from one mine, and cover shipments for a period of eight years. While this ore has been of a fairly uniform grade, it is true there have been some variations in its analyses during the different contract and non-contract periods. It is well known that certain ores are more valuable from the smelters' point of view than certain other ores whose intrinsic value may be the same, depending on their nature as a fluxing or non-fluxing ore; the degree in which they may carry zinc, antimony, arsenic, and other undesirable constituents; and the qualities of the ore which make either for

*Mining engineer, Denver, Colo.

or against the possibility of a high degree of extraction of the metals. Therefore, two grades of ore returning the same gross value may not have the same marketable value. Hence, there is included with each table a typical—not an average—assay of the ore, so that the quality of the ore under discussion may be clearly before us.

The Data Required

The management of the mine from which these shipments were made decided some years ago to tabulate the data from each ore settlement in such a way as to show at a glance its vital statistics. Therefore the following headings were arranged in a horizontal position, and the figures from each settlement were placed under its appropriate division, the different classes of ore, concentrates and crude, being written in different colored inks to avoid any confusion in the ready comparison of similar classes. The subdivisions were: Gross weight; percentage of moisture; net weight; gold assay; total gold ounces; gold value received; gold value per ton; silver assay; total silver ounces; silver value received; silver value per ton; lead assay; total lead pounds; lead value received; lead value per ton; copper assay; total copper pounds; copper value received; copper value per ton; iron assay; insoluble assay; zinc assay; freight; hauling; sampling; assaying; treatment per ton; total treatment; gross value per ton; net value per ton; and (under New York prices) gold value at $20.67; silver value at market; lead value at market; copper value at market; lastly, net proceeds.

When the figures are arranged as in the foregoing classification, certain relationships are at once apparent. If, in any one settlement, from the sum of the gold value received, silver value received, and lead value received, we deduct the sum of the charges for total treatment, freight, hauling, sampling, and assaying of the shipment, we have remaining the net proceeds to the producer. And, further, if in the same settlement we take the sum of the New York values of the different metals, which is the total gross value of the production, as 100 per cent, and use this as a basis, the percentage of these various charges compared with the New York value of the ore is easily shown, and what remains as the "unknown," or the "?," is the proportion left to the smelter to cover its profit, the various losses of metal in smelting and refining, the cost of the items covering transportation of bullion to refinery, cost of refining, transportation of refined product to market, brokerage, interest, and other legitimate charges involved in these transactions. In fact, with the exception of the treatment charge, all the further costs of refining, the losses of metals, and the net profit to the smelter are included in the "?."

What the actual amount of these several items of further cost, loss of metals and net profit may be, it is not possible for me to say, though such additional information from the smelter would be most interesting in connection with the data included herewith. Therefore, for the present, we must be contented with the result showing the division of the 100 per cent. between the miner and the smelter.

Open Market Sale

In Table No. 1 the figures cover a period from April 12, 1900, to Feb. 15, 1901, during which the product was sold on the market without any contract arrangement. A typical assay of this ore shows about the following value: Gold, 0.21 oz.; silver, 16 oz.; lead, 45 per cent.; iron, 14 per cent.; insoluble, 10 per cent.; zinc, 1 per cent. Payment was made for this ore on the following basis: Gold at $19 per oz.; silver, 95 per cent. of the New York price; lead, for 90 per cent. of the contents at the New York price, less 1¼c. per lb. The base was $7.50 per ton, with iron and insoluble paid for and charged for, respectively, at 15c. per unit.

TABLE NO. 1. NON-CONTRACT PERIOD.

April 12, 1900 to Feb. 15, 1901.
Tonnage shipped, net weight, 507.429 tons.

New York Values.		Per cent.
Gold at $20.67	$1,217.25	
Silver at market	3,363.24	
Lead at market	12,590.40	
Total value of product	$17,170.89	
Total marketing expense.	$906.92	5.2817
Net proceeds	7,742.26	45.0895
Producer's portion	$8,649.18	50.3712
Treatment	$2,458.73	14.3192
"?"	6,062.98	35.3096
Smelter's portion	8,521.71	49.6288
Total	$17,170.89	100.0000

In the foregoing table the "total marketing expense" of the shipper includes the items of hauling, freight, custom sampling and assaying. The "net proceeds" represent the balance left him after these items are paid, and is applied to the mining costs and profit. For the smelter's portion the treatment represents the specified treatment cost at the smelter, which may, or may not, be the actual net cost of smelting. When we note that this treatment is 14.31 per cent. of the total gross value of the ore, and amounts to an average charge of $4.85 per ton, it seems unlikely that in this case the actual smelting cost reached such a high figure on this grade of ore, and, therefore, part of this treatment cost would be profit to the smelter. The "?" represents to the smelter the losses of metals in smelting, the costs of transportation of bullion, refining, transportation of refined metals, brokerage, insurance, fixed charges, and profit.

If we assign the metallurgical costs to the smelter and credit it with the total treatment charge, instead of charging it against the miner, we note that the proportion of division between miner and smelter is 50.37 per cent. to the miner and 49.62 to the smelter. That is to say, the smelter pays $8,649.18 for metals worth, in New York, $17,170.89. Or, from another point of view, the smelter levies on the ore for its cost of treatment, marketing expense and profit a total of $8521.71 on 507.429 tons of ore, or an average of $16.79 per ton on ore which averages a gross value of $33.84 per ton.

The First Contract

Table No. 2 covers a period from Feb. 21, 1901, to Feb. 21, 1902, during which the ore was sold to the smelter under a contract. A typical assay of this ore is: Gold, 0.26 oz.; silver, 14 oz.; lead, 44 per cent.; iron, 12.5; insoluble, 10 per cent.

Under this contract gold was paid for at $19 per oz.; silver at 95 per cent of the assay at the New York quotation; lead was settled on 90 per cent. of the contents at the rate of 2½c per pound. The base was $7.50 per ton, with iron and insoluble paid for and charged for, respectively, at 15c. per unit.

It will be noted in the foregoing that no lead payment is made with the New York value as a basis, but on the contrary, a definite rate per pound is named. It is interesting to know that while this payment of 2.5c. per lb. was going to the producer the New York price was $3.95, $4.05, and $4.325 per cwt., the last quotation predominating at the times the different settlements were made.

TABLE NO. 2. FIRST CONTRACT PERIOD.

Feb. 21, 1901 to Feb. 21, 1902.
Tonnage shipped, net weight, 230.401 tons.

New York Values.		Per cent.
Gold at $20.67	$1,176.54	
Silver at market	1,637.48	
Lead at market	5,922.04	
Total value of product	$8,736.06	
Total marketing expense.	$658.82	7.5414
Net proceeds	3,558.05	40.7283
Producer's portion	$4,216.87	48.2697
Treatment	$1,572.56	18.0008
"?"	2,946.63	33.7295
Smelter's portion	$4,519.19	51.7303
Total	$8,736.06	100.0000

In Table No. 2 we find that the percentage of returns is even more unfavorable to the producer than before. The basis of division instead of 50.37 to 49.62 per cent., as in Table No. 1, is now 48.26 per cent. for the miner and 51.73 to the smelter, a decrease of 2.11 per cent. for the producer. The smelter now takes as its portion of the total gross value of $8,736.06 the sum of $4,519.19, or an average of $19.62 per ton on ore which averages a total gross value of $37.92 per ton. The treatment percentage advances from 14.31 per cent., as in table No. 1, to 18 per cent., and while the " ? " to the smelter decreases from 35.30 to 33.72 per cent., or 1.58, the increase in treatment percentage of 3.69 per cent. more than compensates.

Second Non-contract Period

Table No. 3 covers another non-contract period of five weeks, from April 1 to May 10, 1902. During this time a

typical assay of the ore shows: Gold, 0.20 oz.; silver, 17.2 oz.; lead, 38 per cent.; iron, 17.4 per cent.; insoluble, 6.3 per cent.

The base for treatment remains at $7.50, with iron and insoluble paid for and charged for, respectively, at 15c. per unit. The metals are settled on the basis of: Gold, $19 per oz.; silver, New York price for 95 per cent. of the contents, and lead at $2 per cwt., instead of $2.50, as in the preceding contract period, though the New York price remained at $4.05 throughout this time.

Again calculating the percentages on the basis of the New York values we have the following table:

TABLE NO. 3. NON-CONTRACT PERIOD.

APRIL 1, 1902 TO MAY 10, 1902.
Tonnage shipped, net weight, 163.726 tons.

New York Values.		Per cent.
Gold at $20.67	$764.17	
Silver at market	1,426.04	
Lead at market	4,202.85	
Total value of product	$6,393.06	100.00
Total marketing expense.	460.67	7.2058
Net proceeds	2,795.51	43.7273
Producer's portion	$3,256 18	50.9331
Treatment	980.41	15.3355
"?"	2,156.47	33.7314
Smelter's portion	$3,136.88	49.0669
Total	6,393.06	100.0000

The division here between the mine and the smelter is on a basis of 50.93 per cent. to the miner and 49.06 to the smelter, showing an increase of 0.56 per cent. to the producer over Table No. 1, and is, accordingly, the most favorable thus far. The smelter deducts $3,136.88 as its portion of the total gross value of $6,393.06, or at the rate of $19.16 per ton. Of this amount, $5.99 per ton is assigned to treatment and $13.17 per ton to " ? ".

SECOND CONTRACT

Table No. 4 is a summary of the second contract period, from May 20, 1902, to May 20, 1903. A typical assay of the ore shipped during this time shows: Gold, 0.18 oz.; silver, 14.50 oz.; lead, 30 per cent.; iron, 18 per cent.; insoluble, 8 per cent.; zinc, 3 per cent. This contract, for the first time, shows a sliding scale of treatment, and charges a base of $7.50 per ton on ore containing less than 25 per cent. lead; $7 per ton on ore containing between 25 and 30 per cent. lead, and $6.50 per ton on ore containing over 30 per cent. lead. The base is modified as before by the allowance and charge of 15c. per unit on iron and insoluble, respectively.

The metals are paid for as follows: Gold at $19 per oz., when assaying more than 0.03 oz.; silver, "95 per cent. of the assay at New York official quotation on date of first assay. In the event that the official price of silver shall exceed 60c. per oz., then one-third of the excess value over 60c. per oz. shall be deducted from the price of silver used in settlement for ore under this contract," which simply means that the smelter keeps one-third of any excess above 60c. per ounce. Lead, "90 per cent. of lead contents at quotation price less 1½c. per lb., providing ore contains 5 per cent. or over. No pay for lead under 5 per cent. The quotation used in settlement shall be that agreed upon between Utah miners and the smelting company. (Note: This quotation shall be $3.50 per cwt. until Jan. 1, 1903. After Jan. 1, 1903, the quotation to be used in settlement for 90 per cent. of the contents shall be 95 per cent. of the actual sales price in New York of the smelting company's common desilverized-lead product for the week preceding date of settlement.)"

In the terms of this contract it is interesting to know that during the time that $3.50 per cwt. was being used as a settlement basis, and the producer therefore was getting $2 per cwt. for his lead, the actual New York quotations show $4.05 per cwt. from June to December, 1902.

Coming now to the percentages, we find them as follows:

TABLE NO. 4. SECOND CONTRACT PERIOD.

MAY 20, 1902 TO MAY 20, 1903.
Tonnage shipped, net weight, 307.641 tons.

New York Values.		Per cent.
Gold at $20.67	$1,238.96	
Silver at market	2,361.60	
Lead at market	8,071.43	
Total value of product	$11,671.99	100.00
Total Marketing expense.	737.75	6.3207
Net proceeds	4,637.07	39.7282
Producer's portion	$5,374.82	46.0489
Treatment	1,670.48	14.3119
"?"	4,626.69	39.6392
Smelter's portion	$6,297.17	53.9511
Total	$11,671.99	100.0000

From this it will be seen that the basis of division is now 46.04 per cent. to the miner, and $53.95 per cent. to the smelter, which is the least favorable to the producer of all the tables thus far shown. The smelter maintains the percentage of 14.31 per cent., as in Table No. 1, to cover treatment cost. Hence the increase in the smelter's percentage above that of Table No. 1 lies in the " ? " to itself. Under this contract the smelter takes $6,297.17 as its part of the total gross value of $11,671.99, or at the rate of $20.47 per ton. Of this $20.47 per ton the treatment requires $5.43 per ton, and the " ? " the remainder of $15.04.

It is very interesting to note in these tables already discussed that the producer received more favorable returns in Tables No. 1 and No. 3, which are non-contract periods, than in Tables No. 2 and No. 4, when the ore was sold under definite contracts. Thus far, owing to an absence of competition in the field, all the ore had been sold to the same smelter.

THIRD CONTRACT PERIOD

At this point it seemed to the miner that the division of values had been too uneven in proportion to the respective working costs of the miner and smelter, however evenly the division may have been made on a percentage basis. Therefore, in placing the next contract, a bid was obtained from the smelter which had purchased the ore heretofore, and whose reduction plant was only 18 miles from the producer, and the terms offered were an advance of 8c. per ton in net value on the preceding contract just shown in Table No. 4. This was deemed unsatisfactory, and a bid was secured from an independent smelting company whose plant was located in another State, and at a distance of over 500 miles from the producer. The latter bid was the better and was accepted, though the former company expressed regret, since it was "in the habit of meeting the bids of competitors."

A typical assay of the ore shipped under this new contract shows the following values: Gold, 0.30 oz.; silver, 18 oz.; lead, 40 per cent.; iron, 17 per cent.; insoluble, 12 per cent., and zinc, 2 per cent. The treatment base is $6 per ton on ore containing over 30 per cent. lead, and $8 per ton for ore containing less lead. No allowances nor charges are made for iron and insoluble contents. Zinc to the amount of 7.5 per cent. is allowed free.

The metals were paid for as follows: Gold, $19 per oz.; silver at New York quotations for 95 per cent. of the contents; lead, full contents at 45c. per unit, this price based on lead quotation of $3.75 per cwt. (This quotation paid 2¼c. per lb. reckoned on same basis as preceding contracts.) For each 5c. increase or decrease in the lead quotation add or deduct 1c. per unit to or from above price. The smelter's own quotation for lead to be used.

In this connection it should be pointed out that the New York price for lead was $4.05 per cwt. when the above basis of $3.75 was being used, but it should also be noted that payment was made for full lead contents on fire assay, instead of on 90 per cent. of the contents, as in the preceding contracts.

Arranging the data from these settlements, we obtain the following table:

TABLE NO 5. THIRD CONTRACT PERIOD.

JUNE 1, 1903 TO JUNE 1, 1904.
Tonnage shipped, net weight, 79.358 tons.

New York Values.		Per cent.
Gold at $20.67	$566.56	
Silver at market	769.93	
Lead at market	2,811.50	
Total value of product	$4,147.99	
Total marketing expense.	211.44	5.0974
Net proceeds	1,957.67	47.1956
Producer's portion	$2,169.11	52.2930
Treatment	476.27	11.4820
Freight at $6.50 per ton.	526.27	12.6873
"?"	976.34	23.5377
Smelter's portion	$1,978.88	47.7070
Total	$4,147.99	100.0000

In this table the division between producer and smelter is on a basis of 52.29 per cent. to the former and 47.70 to the latter; and in addition the freight on the ore for a distance of more than 500 miles

is paid by the smelter. The increase in favor of the miner, from the terms of table No. 4, is 6.25 per cent., and at the same time the " ? " to the smelter is reduced to 23.53 per cent., owing to the additional freight against him. Disregarding the freight charge, in order to make a comparison of the similar items in the preceding tables, we find that the smelter takes as its toll $1,452.61 for 79.358 tons, having a gross value of $4,147.99, or at the rate of $18.30 per ton. Of this $18.30 the treatment requires $6, and the " ? " $12.30. The treatment percentage falls from 14.31 per cent. (the lowest rate in the first four tables) to 11.48, a decrease of 2.83 per cent. The " ? " to the smelter decreases from 33.73 per cent. (the lowest rate in the four preceding tables) to 23.53, or a decline of 10.20 per cent.

So, we note that this independent smelter pays a freight charge of 12.68 per cent. —not charged against the "trust" smelter in the preceding table—which gave a decreased treatment rate of 2.83 per cent.; and also got a decreased " ? " rate of 10.20 per cent., thus making a total decrease of 25.71, and yet does business at a profit. We may, therefore, be justified in believing that this must have represented all profit to the "trust" smelter. The natural conclusion from a comparison of Tables No. 4 and No. 5 is that in some degree competition is becoming a factor in this particular producer's calculations.

Fourth Contract

When the preceding contract expired, in June, 1904, an independent smelting company was adding lead furnaces to its copper-smelting plant in the vicinity of the "monopoly" smelter. In preparation for the beginning of custom-lead smelting in the early fall of that year, the independent company was engaged in making ore contracts and in filling its ore bins. Now, for the first time, the producers tributary to this smelting center seemed to be in a fair way to profit by any results of thorough, earnest and insistent competition. The two competing lead smelters were in close proximity, the resources of each were considerable, and the fact that the furnaces of the independent smelter were to be operated as an auxiliary to its copper smelter argued that it would have the marked advantage of a lower operating cost. Therefore, it seemed natural that the miner would obtain more favorable terms from the new company than from the old, and that he would at least be assured of a higher return on his product now, through the excitement of competition.

The next Table, No. 6, is from a two-year contract with the independent smelter, from June 1, 1904, to June 1, 1906. In the shipments made during that period a typical assay shows: Gold, 0.15 to 0.22 oz.; silver, 12 to 15 oz.; lead, 22 to 28 per cent.; iron, 25 to 28 per cent.; insoluble, 4 to 6 per cent.; zinc, 5 per cent.

The contract under which these shipments were made contained the following clauses regarding payment for ores: Gold at $19 per oz. for all in excess of 0.03 oz. per ton. Provided, that all settlements in which the gold amounted to 0.25 oz. or more per ton were to be paid for at $19.50 per oz. Silver, 95 per cent. of the New York quotation on date of first assay for full silver contents. Lead, payment to be made for full contents at Engineering and Mining Journal average quotation for week previous to date of assay, less 2c. per pound. Iron and insoluble, paid for and charged for, respectively, at 10c. per unit. Zinc, 8 per cent. free; over 8 per cent., charged for at 30c. per unit. Speiss, 6 per cent. free. Over 6 per cent., charged for at 20c. per unit.

Treatment charges were based on a sliding scale, varying according to the lead contents as follows: 5 to 10 per cent. lead, treatment, $9 per ton; 10 to 15, $8; 15 to 20, $7; 20 to 25, $6; 25 to 30, $5; 30 to 35, $4; 35 to 40, $3; 40 to 45, $2; 45 per cent. and over, $1 per ton.

Tabulating the returns under this contract we have this table:

TABLE NO. 6. FOURTH CONTRACT PERIOD.

June 1, 1904 to June 1, 1906

Tonnage shipped, net weight, 1951.289 tons.

New York Values.		Per cent.
Gold at $20.67	$7,011.74	
Silver at market	15,269.76	
Lead at market	46,430.07	
Total value of product	$68,711.57	
Total marketing expense.	2,869.43	4.1760
Net proceeds	37,363.45	54.3772
Producer's portion	$40,232.88	58.5532
Treatment	8,374.67	12.1882
Freight at 75c	1,500.59	2.1838
"?"	18,603.43	27.0748
Smelter's portion	$28,711.57	41.4468
Total	$68,711.57	100.0000

In Table No. 6 we find that the producer now obtains 58.55 per cent. of the gross value of the product, and the smelter 41.44 per cent. It should also be noted that the smelter receives the ore f.o.b. at the shipping point, and hence the freight from the shipping point to the smelter, which would cost the shipper $1500.59, or 2.1838 per cent. of the total value of the ore, is paid by the smelter.

The smelter now pays $40,232.88 for ore having a gross value of $68,711.57, or an average gross value for the 1951.289 tons of $35.21 per ton. Disregarding the freight paid, the smelter takes as its share of the product the sum of $26,978.10, or at the rate of $13.82 per ton. Of this $13.82 per ton, the treatment charges consume $4.29 and the "?" the remaining $9.53.

We find that the "?" for the smelter is 27.07 per cent., which is a noteworthy decrease from the percentage in Table No. 4, when the ore was smelted in the same locality and the smelter took a "?" of 39.63 per cent., and made the treatment percentage 14.31 per cent., as compared with the rate of 12.18 per cent. in this last table. The increase in percentage to the producer over Table No. 5 is 6.26 per cent., and over Table No. 4 it is 12.51 per cent., even though we disregard the fact that the smelter is now paying the freight, which, if charged to the producer, would add 2.18 per cent. to these increases, bringing them to 8.44 and 14.69 per cent., respectively.

In this last contract we begin to see the results of a competition which is becoming earnest, and yet it would seem that the smelter is making a handsome return on its investment.

Fifth Contract

Coming now to the final contract period which extends from June 1, 1906, to June 1, 1908, we have arranged the figures to cover shipments from the beginning of the contract to the expiration of the year 1907.

A typical assay of these shipments shows the following values: Gold, 0.13 oz. silver, 12 oz.; lead, 21 to 27 per cent.; iron, 24; insoluble, 6; zinc, 7 per cen. These assays show a decrease in the value of the ore from the high returns of the early contracts, when the lead assayed 45 per cent., but the selling contracts show a steady improvement in terms, nevertheless.

The terms of this contract provide for the following payments: Gold, all gold at $19.50 per oz., if ore assays over 0.02 oz. per ton; silver, full contents at 95 per cent. of the New York quotation; lead, 90 per cent. of the contents at the New York quotation in the Engineering and Mining Journal for the week in which ore is delivered, less 1½c. per pound; iron and insoluble, paid for and charged for, respectively, at 10c. per unit; zinc, 12 per cent. free. Over 12 per cent. charged for at 30c per unit.

Again we have a sliding scale for treatment on the following basis: 5 to 10 per cent. lead, treatment charge, $7.25 per ton; 10 to 15, $6; 15 to 20, $5; 20 to 25, $4; 25 to 30, $3; 30 to 35, $2.25; 35 to 40, $1.35; 40 to 45, $0.50; 45 to 50, no treatment charge; 50 to 55, bonus of $0.75; over 55 per cent., bonus of $1.25 per ton.

It will be noticed, on comparing this schedule with that of the preceding contract, that the treatment charge on the grade of ore shipped by the producer, between 20 and 30 per cent. lead, is reduced $2 per ton. The deduction made on the price of lead is only 1½c. per pound, instead of 2c., but payment is made for only 90 per cent. of the lead contents, in stead of 100 per cent., as in the preceding contract. The gold item is also considerably increased by the payment of $19.50 per oz. for all ore—since in no case did the shipments carry less than 0.02 oz. per ton—instead of paying the $19.50 only

when the assay was in excess of 0.25 oz. per ton.

The result of these changes for the better is clearly apparent in the following Table No. 7:

TABLE NO. 7. FIFTH CONTRACT PERIOD.

JUNE 1, 1906 TO JUNE 1, 1908.

Tonnage to end of 1907. net weight, 2877.174 tons.

New York Values.		Per cent.
Gold at $20.67	$7,806.44	
Silver at market	23,346.30	
Lead at market	64,443.46	
Total value of product	$95,596.20	
Total marketing expense.	4,675.96	4.8913
Net proceeds	67,202.68	70.2985
Producer's portion	$71,878.64	75.1898
Treatment	6,493.54	6.7927
Freight at 75c	2,269.85	2.3744
"?"	14,954.17	15.6431
Smelter's portion	$23,717.56	24.8102
Total	$95,596.20	100.0000

These figures show still another change for the better from the producer's point of view. The smelter continues to pay the freight, which amounts to 2.37 per cent. of the gross value of the ore, and the treatment charge is reduced to 6.79 per cent., representing a gain to the miner of 5.39 per cent. over Table No. 6. The division between the miner and smelter is now on a basis of 75.18 per cent. to the former and 24.81 to the latter. Again, disregarding the freight paid by the smelter, in order to have similar figures to compare with the earlier tables, we find that from the total gross value of $95,596.20, which gives an average value per ton of $33.22, the smelter deducts, to cover both treatment and "?" costs, the sum of $21,447.71, or an average of $7.45 per ton. This $7.45 is distributed between treatment and "?" in the average proportion of $2.26 for treatment, and $5.19 per ton for "?."

The "?" factor for the smelter is now only 15.64 per cent. of the gross value of the ore, which compares very favorably for the producer with the 27.07 per cent. of the immediately preceding contract, and with the 39.63 per cent of Table No. 4, when the ore was smelted by the "trust" in the same locality.

The notable increase in favor of the producer between Table No. 6 and Table No. 7 can hardly be ascribed simply to the element of competition, though it undoubtedly played a large part in the improvement. When shipments were begun on the contract tabulated under Table No. 6, the producer commenced keeping a record of these shipments after the manner heretofore described in this paper, for the purpose of having the complete figures to show to the smelter when the succeeding contract should be negotiated. In accordance with this plan the essential data of Table No. 6 were laid before the smelter representative, and to these results shown were due in large part the more favorable terms of Table No. 7. Hence my contention, that if the producer negotiates his contract in the complete understanding of what he has been getting, and of what he should get, he is more likely to receive better terms than if he signs a contract in ignorance of these vital facts.

General Summary

Bringing now before us a tabulation which shows the vital figures from all the foregoing tables, in order to inspect at a glance the relations between them, we find the data given in Table No. 8.

Analyzing these figures we note that during the period covered by the first four tables, when the smelting business was under monopolistic conditions, the smelter divided with the producer on such terms that the smelter received from 49 to 53.9 per cent. of the gross value of the ore, out of which to recover its bullion and to pay all costs of smelting and subsequent processes until the refined product was marketed. When the producer shipped to an independent plant outside of the State, his gain, as represented in the difference between Tables 4 and 5, was 6.25 per cent. over his returns when shipping to the nearer "trust" smelter. Comparing Tables 4 and 6, we see that when an independent smelter was started in the same vicinity as the "trust" plant, the producer gained 12.50 per cent. over his last rate from the "trust" smelter. And when we compare Tables No. 4 and No. 7 we see that in three years the combination of competition between the smelters and sophistication of the producer resulted in a gain to him of 29.14 per cent.

The "smelter's portion, per cent." is subdivided into the items of treatment, freight, and unknown, or "?." The item of freight is blank in the first four tables, because the producer paid it, and it is included in the producer's portion.

Reading down the column of treatment, the notable fact is the sudden decrease in the rate between Tables No. 6 and No. 7. In fact, this marked difference between these two tables is shown in each column, and it is worth pointing out again that at the expiration of the contract covered by Table No. 6 the results were brought to the attention of the smelter before the following contract was written.

The column of freight shows the highest cost to the smelter when the ore was shipped 500 miles to the reduction works.

The column of unknown, or "?" shows the greatest decline after Table No. 4, and during the time covered by the first four tables the smelter had a large allowance in this item.

The column of average gross value per ton indicates that the value of the ore on the market remained fairly constant during all this time. But, as a matter of fact, the typical assays show that the metal content of the ore was steadily falling off, and the lead dropped from 45 to 25 per cent., but the rise in the New York metal market counteracted this decrease in the ore.

In the average total deduction per ton by smelter we see a steady decline from Table No. 4, with the notable change at the very last. These declines in this column indicate corresponding improvements from the producer's point of view.

TABLE NO. 8. GENERAL SUMMARY.

	Producer's Portion, Per Cent.	Smelter's Portion, Per Cent.	Treatment, Per Cent.	Freight, Per Cent.	Unknown, "?" Per Cent.	Average Gross Value Per Ton.	Average Total Deduction Per Ton by Smelter.	Av'ge Deduction Per Ton for Treatment.	Average Deduction Per Ton for "?"
Table No. 1	50.3712	49.6288	14.3192	.....	35.3096	$33.84	$16.79	$4.85	$11.94
Table No. 2	48.2697	51.7303	18.0008	.....	33.7295	37.92	19.62	6.82	12.80
Table No. 3	50.9331	49.0669	15.3355	.....	33.7314	39.04	19.16	5.99	13.17
Table No. 4	46.0489	53.9511	14.3119	.....	39.6392	37.94	20.47	5.43	15.04
Table No. 5	52.2930	47.7070	11.4820	12.6873	23.5377	52.27	18.30	6.00	12.30
Table No. 6	58.5532	41.4468	12.1882	2.1838	27.0748	35.21	13.82	4.29	9.53
Table No. 7	75.1898	24.8102	6.7927	2.3744	15.6431	33.22	7.45	2.26	5.19

Total Treatment Charges

The sum of the last two items in each table is the average total deduction per ton by smelter, and illustrates how the division of the total deduction was made. If a producer were to ask for a contract from the smelter on these terms, that the smelter was to pay for the full metal content at the New York prices, and to make all its charges in one lump sum, called treatment, the proportion of this treatment charge to the total value of the ore would be clearly apparent. Too apparent, in fact, from the smelter's viewpoint. For example, any producer would throw up his hands in horror if on an ore worth $33.84 per ton the smelter should put a treatment charge of $16.79, as is the case in Table No. 1. But Table No. 7 shows that on an ore worth $33.22 per ton the smelter took only $7.45 to cover all its metallurgy costs and its profit. Why not simplify contracts in this manner?

The Mining Districts of Central Peru

A Number of Camps within Comparatively Short Distances of Cerro de Pasco Are Showing Activity, Producing Silver, Copper, Coal and Lead

BY J. C. PICKERING*

The Morococha district which previous to 1894 was practically unexploited for copper, is today, next to Cerro de Pasco, the foremost mining camp in Peru. The fact that the region is tapped by a 13-km. branch of the Peruvian Central Railroad, has no doubt assisted in bringing the camp to its present advanced condition. The proximity of the Backus & Johnston custom smelter, distant 20 km. by trail, has also aided in developing the industry. The mineralized portion, as at present known, is included in an area approximately one and one-half by five miles in extent. That the mines were worked by either the Spaniards or Indians is evidenced by the great numbers of old workings, which have been encountered even in depth. When it is borne in mind that rock was broken by alternate heating and cooling and that animals' horns were used as excavating implements, the fact that the ancients worked mines so thoroughly suggests a practically unlimited supply of slave labor.

After the Spanish regime, the mines were worked in a desultory fashion until about 1850, when Messrs. Pflucker & Co. built the Tuctu amalgamation and lixiviation plant. The members of this firm were at that time practically the sole operators in the region; they also worked veins for silver only. The Tuctu plant consisted of arrastres, the necessary vats, calciners, etc., and was operated by a 24-ft. overshot water wheel. The material for the construction of the plant was packed in on mule back from Lima, a distance of 184 km., for at that time the railroad had not been built. Pflucker & Co. also acquired the water rights of the large lakes, Huacraccocha, Morococha, and Huajcacocha, the total fall from the upper to the lower being 900 ft., and capable of developing about 1000 h.p. This water concession has since proved to be a most valuable asset.

It was not until 1886 that the Pfluckers met with any serious competition. In that year the Señores Montero began working their mines, San Antonio and Vicha-rayoc, employing about 300 men and shipping monthly between 450 and 500 tons of ore, assaying 50 per cent. lead and 60 oz. silver. In 1890 the grade of the ore began to fall off, and it was decided to build a concentrator on the lower lake, to be connected by means of a narrow-gage railroad with all the Montero properties. Fully £100,000 was spent in this work, covering a period of two years. The mill was built, but the Pfluckers controlled all the heavy water-power and it became necessary to use a small variable stream, having, however, considerable head. This water never was sufficient for the purpose. As regards the railroad, a large part of the

GENERAL VIEW, BACKUS AND JOHNSTON CUSTOM SMELTING WORKS, CASAPALCA

*Mining engineer, El Oro, Mexico.

grading was done, but the line never operated. One of the branches was located to cross Morococha lake but the fill proved too expensive and was abandoned.

An individual fortune of nearly £100,000 was made by Victor Vaunoni, from the Cajoncillo mines, within a period of five years. The only other mines of importance operating in the early nineties are those of San Florencio. These mines which are located in what may be called the gold zone of Morccocha, are worked on veins carrying a narrow pay streak, 2 to 6 in. wide, carrying a high proportion of silver and up to 10 oz. gold. These properties are now under consideration for purchase by the Casapalca smelter company, the price asked being £60,000.

About 1894 the price of copper having risen, attention was paid to the San Miguel mine, which for the past 40 years had been supplying sulphates of copper to the Tuctu works to be used in the amalgamation process. The mine was denounced by Lizandro Proaño, an Indian who was at that time working as a *capachero* in the Huillca mine. The mine paid from the beginning, but in order to work on a more extensive scale, the Sociedad Minera Copay-Cocha was organized in which Proaño retained a 40-per cent. interest, the society agreeing to furnish £1500 to start operations. The mine has produced to date not far from 40,000 tons of ore, averaging 15 per cent. copper. After working the rich oxidized croppings of the vein, a 550-meter tunnel, giving 90 meter backs below the next tunnel level, was run to tap the ledge in depth. In 1905 the interest of Proaño's partners, Stuart and Valentine, and representing 60 per cent. of the Copay-Cocha holdings, was bought by the Cerro de Pasco Mining Company, together with the entire Pflucker and Montero estates, a large part of the Valentine properties and many other small holdings. Proaño has recently sold his 40 per cent. of the San Miguel mine, together with some other smaller considerations, to the Cerro de Pasco Company for about £100,000.

Minerals of Morococha

The rocks of the region are quartzites, limestones and marbles, which have been greatly disturbed and metamorphosed and in which have been intruded enormous masses of eruptive rocks, principally andesites and dacites. The orebodies may be divided into four classes: (1) Large lenses or masses, conforming in dip to the bedding planes of the sedimentary rocks and probably due to replacement; (2) mineralized fissures in the sedimentary rocks, crossing the bedding planes at various angles; (3) contact orebodies, found, as the name implies, on the contact of the eruptive with the sedimentary rocks; (4) a powerful parallel system of mineralized fissures, cutting the eruptive rocks and retaining an almost constant strike of north 60 deg. east, and south 60 deg. west. This last class includes most of the copper producers of the district: San Francisco, San Miguel, La Huillca and others, but not the producing mines, Churruca, Gertrudis and Alejandria, which are represented in classes 1 and 2.

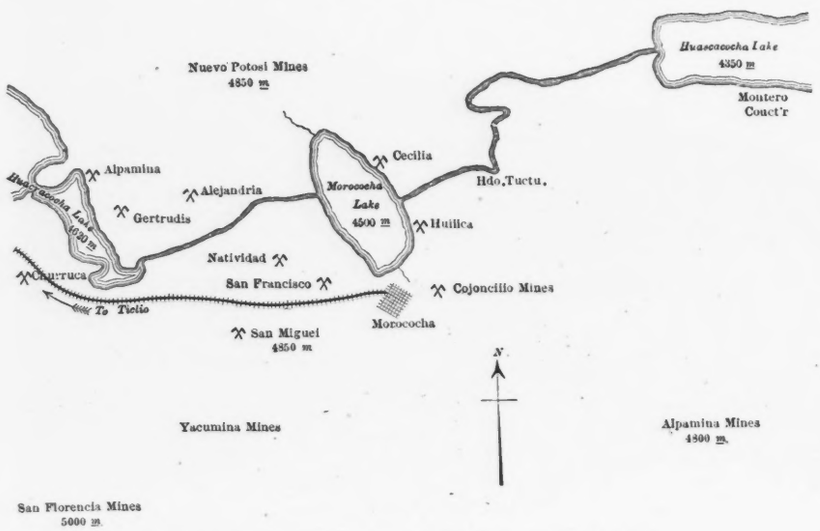
The principal copper ores are enargite, tetrahedrite and chalcopyrite, generally mixed with pyrite, blende and galena, and usually associated with a quartz or calcite gangue. In general the copper-producing veins carry little silver, a 15-per cent. copper ore running from 7 to 10 oz. The other class of mines known as the silver producers of which Alpamina is an example, produce principally galena and oxide ores (pacos) with silver up to 3,000 ounces.

A detailed description of any of the Morococha mines does not come within the scope of this article, but I present herewith in tabulated form data concerning several of the principal mines of the district. It is practically impossible to secure accurate information regarding these properties, but in round numbers the data are correct. The information given covers the year 1904-1905, representative of the operation of the several properties before the advent of the Cerro de Pasco Mining Company. This company, after completing the purchase, curtailed productions in order to put the mines in shape for systematic development and extraction.

PRODUCING MINES OF THE MOROCOCHA DISTRICT.

Name of Mine.	Number of Men.[1]	Wages per Shift.	Average Per Cent. Copper.	Grade of Ore. Silver. Oz.	Grade of Ore. Gold. Oz.	Value per Ton.[2]	Average Production, 1904–1905, in Tons.
San Miguel	200–300	40c	17	7		47.70	5000
Natividad	75–100	35	14	14	43.40	43.40	2500
San Francisco	60–90	45	18	8		50.80	1500
Gretrudis	40–50	40	14	20		46.40	2500
Alpamina	150–200	45	2	100 to 300		variable	3000
Yanamina	20–30	35		150		75.00	200
San Florencia	40–50	45		100 to 200	1.5 to 2.5	variable	150

[1]These men work nine shifts per week, six days and three nights.
[2]Estimated on a basis of copper at 13c. and silver at 50c.



PRINCIPAL MINES OF THE MOROCOCHA DISTRICT, PERU

As regards new locations or denouncements, Morococha is by far the most active mining camp in Peru. There are at present 1700 claims, which have been taken possession of and titles for which have been approved, or are ready for approval by the Government; the *delegado* informs me that he is giving possession at the rate of 400 to 500 claims yearly. In 1902 the Government established an engineering commission composed of from three to five surveyors for the purpose of making a claim and topographical map of the region, locating cornerstones, acting as experts in boundary suits, etc.

The advent of the Cerro de Pasco Mining Company in 1905; the Peruvian Mining, Smelting and Refining Company, which purchased the Churruco mine and was building a 200-ton custom smelter at Rio Blanco in 1906; and the active purchasing of mining properties by the Casapalca smeltery of Backus & Johnston brought a new era to the camp. The first shaft which was sunk and equipped by the Cerro de Pasco Mining Company to work the San Francisco vein was promptly followed by similar operations on the part of the Backus & Johnston Company at the Natividad property, the owners of the Alejandria mine, and recently by others.

During the high copper prices prevail-

ing during 1907, all dumps were repicked and many thousand tons of ore averaging as low as 6 per cent. copper and 6 oz. silver, were shipped to the custom smelters at a profit.

Custom Smelters

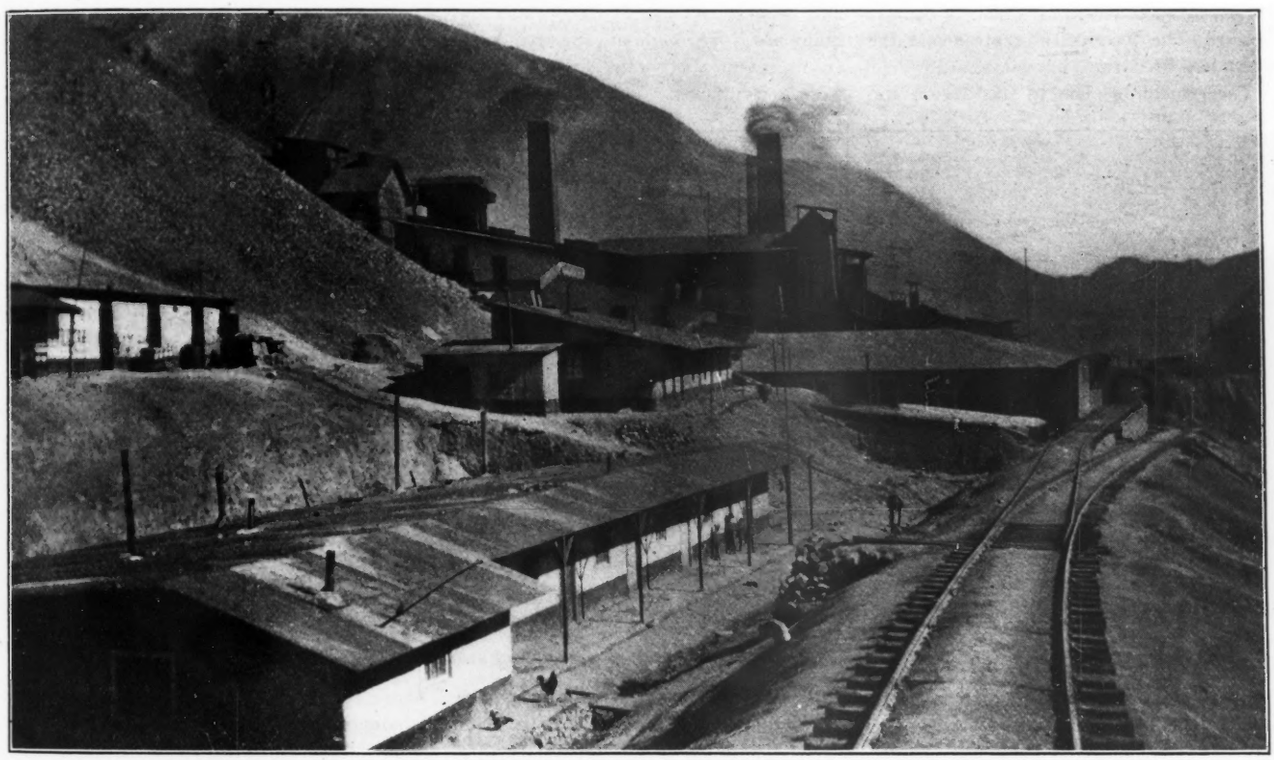
Of the custom smelters in the vicinity of the Morococha region two are located in Yauli, the Santa Barbara and the Carmen; one is on the shore of Huacracocha lake, and the largest, that of Backus & Johnston, is at Casapalca. The Casapalca plant is situated on the line of the Peruvian Central Railroad, 154 km. from Callao at an elevation of 13,600 ft.; it is the most active of these smelters, and was originally a small concentrating plant. An addition of a lead furnace was subsequently made, which was in operation up to 1894. Previous to this date no attention had been paid to copper ores and the copper in purchased ore was not paid for.

In 1894 the price of copper having risen and several mines having been operating for copper alone, the plant was permanently changed and enlarged to treat copper ores. At present two 33x60-in. water-jacket furnaces, having a capacity of 75 tons each, are smelting a charge of green ore mixed with the calcined product of two Brown mechanical roasters. Mattes averaging 55 per cent. are obtained and are shipped to Europe for treatment. The plant is operated by water-power. Labor ranges from 50c. to $2 per 12-hour shift; coke costs approximately $25 per ton at the plant; 12 per cent. coke is the usual proportion used in the charge.

The Santa Barbara plant is located at Yauli, 194 km. from Callao at an elevation of 13,420 ft. This plant is at present operated by F. Mella who is acting for Aaron Hirsch & Sohn, and is working purely on custom ores. There are three furnaces with a combined capacity of 120 tons per 24 hours. There is one 44x66-in. furnace with a capacity of 75 tons; one 44x48-in. with a capacity of 30 tons and a third 30x46 in. at the tuyeres having a capacity of 15 tons. The plant is equipped with hand reverberatories. The blast is furnished by a water turbine, belted to a Root No. 8 blower. The furnaces are operating under a 16-oz. blast and are using 8 per cent. coke, costing $28 per ton at plant. Mattes running 45 to 55 per cent. copper are produced. The Carmen and Huacracocha plants are small, and are not at present in operation.

At present the smelting charge at Casapalca is $22.50 per ton of 2000 lb., and at Yauli $17.50. In purchasing gold-silver-copper ores, the smelters pay for (1) copper, less 1.3 per cent., or 90 per cent. of the wet assay value, at existing London price for best-selected grade, less £14 per ton, this deduction to cover cost of shipping and insuring matte to Europe together with converting and refining charges; (2) 95 per cent. of the silver assay; and (3) 95 per cent. of the gold assay, providing the gold exceeds $6, less not being paid for.

Assuming the grade of the ore to be 15 per cent. copper and 10 oz. silver, and copper to be worth 15c. per lb. and silver 60c. per oz., the cost of marketing ore from the Morococha mines is as follows: Shipping ore direct to Europe—sacking, $1.10 per ton; transporting ore to the railroad station 60c.; freight from Morococha to Callao, $8.50; shipment and insurance to Europe and treatment charges, $20; total, $30.20; the value of the ore of the assumed grade will be $46.80 per ton, and the profits, disregarding mining cost, $16.60. In case the ore is smelted at a local custom plant, the cost will be as follows: Sacking (sacks reused), 50c.; transportation to the smelter, $3; treatment charge, $17.50; total, $21. Smelter deducts £14 from the London price of copper per ton, making the market value of the ore $38.60, and leaving a profit, disregarding mining costs, of $17.60. With 15-per cent. ore, 15c. per lb. as the price of copper is the turning point in the method of disposition; higher-grade ores are invariably sent to Europe and lower grades sent to the local plants.



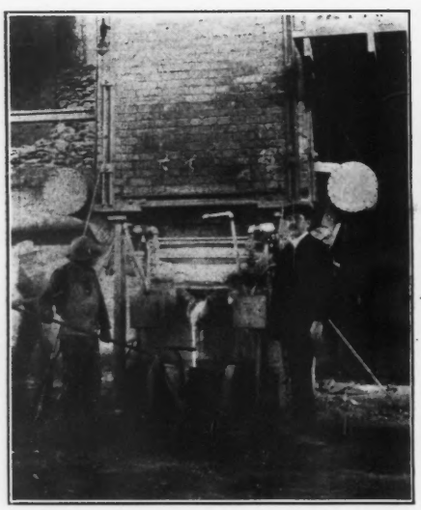
SMELTING WORKS, BACKUS AND JOHNSTON, CASAPALCA

Pacococha and Tamboraque Smelter

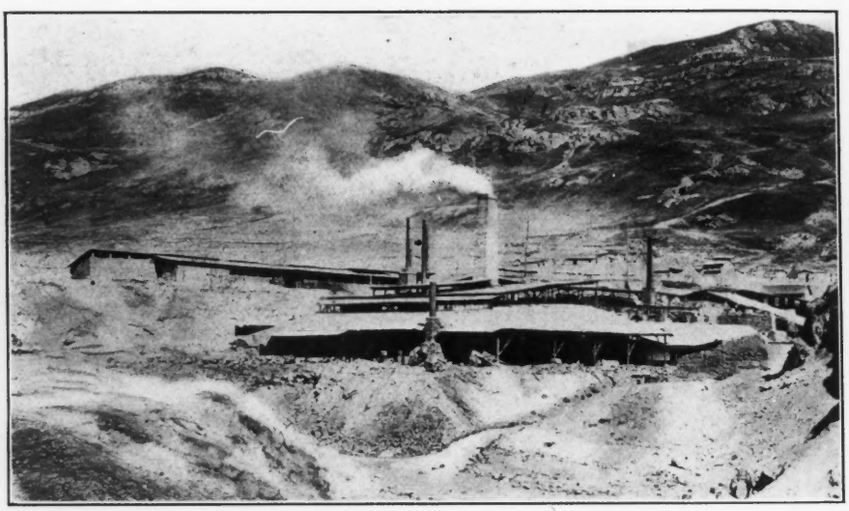
The remaining active camp of importance is that of Pacococha, at an elevation of 15,500 ft. and 20 km. from Tamboraque, a point on the Peruvian Central Railroad. This latter place is 120 km. from Callao and has an elevation of 9820 ft.

The formation here is largely andesite and dacite, cut by a strong system of mineralized fissures, generally carrying argentiferous chalcopyrite and bornite. The producing mines are for the most part controlled by L. Proaño, discoverer of the San Miguel mine. The principal producer is the Germania vein, 3 to 6 ft. wide, and the ore varies from 7 to 15 per cent. copper and 10 to 20 oz. silver. The ground here is extremely hard, making mining costs very heavy. Since the sale of Sr. Proaño's 40 per cent. of San Miguel, the Pacococha mines have been exclusively supplying his Tamboraque smelter. This plant, which was designed and constructed by Raymond Guyer, has been in operation about two years. It consists of one water-jacket furnace having a capacity of 40 tons per 24 hours, a Brown roaster, etc., and is run by water-power. The location is central and the plant has been run very successfully.

The remaining plant of this region and the one that will, when completed, undoubtedly be the most up-to-date custom plant in Peru, is that being constructed by the Peruvian Mining, Smelting and Refining Company, at the Rio Blanco, along the line of the Peruvian Central Railroad 135 km. from Callao, at an elevation of 11,500 ft. The plant, which is to have a capacity of 200 tons per 24 hours, is modern and complete in all respects. I understand that the furnaces are to be blown in in the spring of 1908. The rate to be charged has not been made public yet.



FURNACE, SANTA BARBARA PLANT



SANTA BARBARA CUSTOM SMELTERY, YAULI, PERU

Province of Cajatambo

The mines of the Cajatambo region can best be divided into two groups: (1) The coal regions surrounding the town of Oyon, which has an elevation of 10,000 ft., and is located 70 km. west of Cerro de Pasco and 168 km. from the port of Huacho; (2) the principal metal regions foremost among which are those belonging to the Quichas *hacienda* and those in the vicinity of Chanca.

Oyon and its surrounding coalfields are one and one-half days' journey from Cerro de Pasco, the larger part of the first day being occupied in crossing the *pampa* of Junin. There is at present no other communication except the trail. Along the western border of the Junin *pampa* lie the first ranges of the cordillera. Once having passed these, however, a rapid descent is made to Oyon. The country is rugged and precipitous.

As at present developed, the principal coal seams are found in Conocpata hill. The carboniferous region is, however, a large one, covering a district about five by ten miles and is by no means limited to the hill named. The coal-bearing formation consists in general of sandstones and shales, of which the former predominate. Throughout the region the seams retain a constant strike of northwest to southeast. The coal is variable; both coking and non-coking bituminous are found, and also anthracite; the width of the seams varies between one and ten feet.

Most of the coking and mining to date has been done in Conocpata hill, but no systematic extraction has been attempted, the object being merely to drive from 50 to 100 ft. on the seam and then when the roof begins to cave and the tramming distance laborious, to abandon the tunnel and start another. Mining and coking are for the most part done by contract, the average prices paid per ton of coke being $10 to $12. Transportation of this coke to Cerro de Pasco by llamas costs $7 per ton. The following are average analyses on these coals:

COMPOSITION OF OYON COALS.

	Bituminous.	Anthracite.
Volatile matter	20-28 per cent.	6-9 per cent.
Fixed carbon	60-67	79-83
Ash	4-10	8-15

At the time when it seemed probable that a railroad would be built, connecting Cerro de Pasco with Huacho, more than 20,000 *hectares* of ground were denounced in this region.

There is a good market for the low-ash coke (12 per cent.) of this region in Cerro de Pasco, and if ovens were introduced, Oyon coke could, I believe, compete with the imported German. As it is, the coke lacks strength for smelting purposes, due to the system employed in its manufacture. Conical heaps of coal are built with a hole or chimney in the center. This hole is then filled with the branches of small knotty trees which abound in the region and the heap ignited. It is usually allowed to burn over night, or roughly, 20 hours. A heap made of a ton of coal gives from 300 to 500 lb. coke. The system is primitive and very wasteful.

Chanca is situated 15 km. north of Oyon, at an elevation of 16,000 ft. The mines there have the usual history attached to all mines worked by the Spaniards, involving the extraction of fabulous amounts of native silver and ruby silver. The hill is of eruptive origin, and is crossed by a series of mineralized fissures which have various strikes and which at their intersection form rich shoots or bonanzas. The mines were worked previous to 1700; the upper portions of the vein have been thoroughly extracted. The present owners are working the lower levels by means of two long crosscuts. The veins, which are from one to 10 ft. in width, carry tetrahedrite, galena, mispickel, enargite and various silver ores, associated with a quartz and decomposed porphyry gangue. The silver content is very variable, ranging from 10 to 500 oz. per ton. Since 1902 practically all ores from these mines have been treated at the Gasuna lixiviation plant situated 7 km. south of the mines, by the following process:

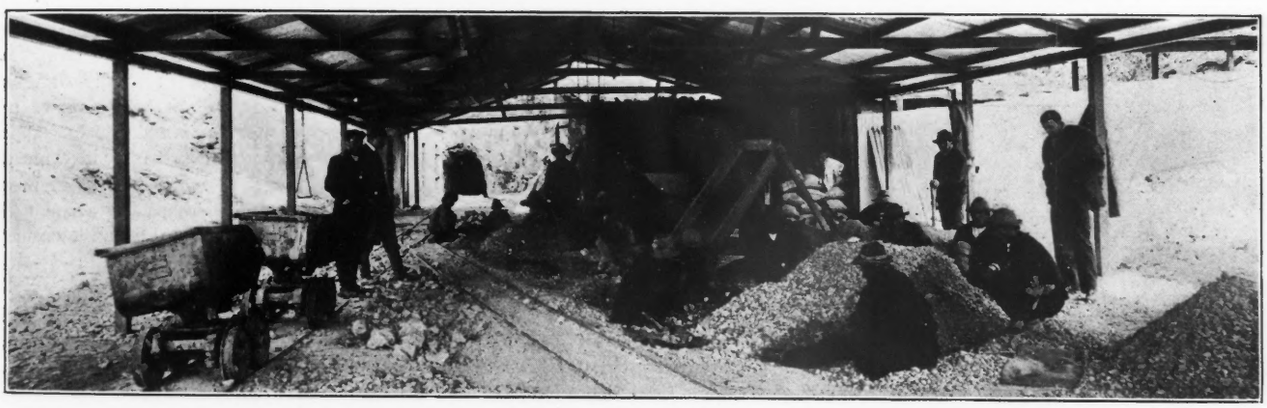
The ore after crushing in a Dodge crusher, is submitted to a preliminary

roasting in reverberatory furnaces, having a capacity of 15 tons each, reducing the sulphur to about 15 per cent. The idea of this first roast which costs about 50c. per ton, is to reduce the amount of salt necessary for chloridizing roast, and also reduce the time required for this roast. The partly calcined product after cooling is crushed in a five-stamp battery, the stamps weighing 900 lb. and having a drop of 8 in.; from the stamps the ore passes to a ball mill, and through a 20-mesh screen. The product is then subjected to a five-hour chloridizing roast at a low heat in reverberatories, using 6 per cent. salt. After cooling, the roasted material is transferred to 12 leaching vats, and subjected to a 24-hour water leach in order to extract soluble sulphates. The wash water is run to a precipitating tank, allowed to settle, filtered and rejected The ore, after being water washed, is subjected to a 48-hour leach with a 0.5 per cent. hyposulphite solution. The silver slimes are precipitated from the solution by sulphide of lime and are dried and pressed; they average 400 fine.

The mill is run by water-power, using a Pelton wheel in conjunction with an overshot water wheel. Two 12-hour shifts of 10 to 12 men are required, at average wages of 40c. per man. The capacity of the plant under these conditions is about six tons per 24 hours. The average treatment charge per ton of ore, including labor, supplies, fuel, etc., is $6 At present the extraction is about 75 per cent.

The remaining regions of importance in mining in central Peru are for the most part controlled by Simon P. Dunstan, also owner of the Quichas *hacienda,* situated 8 km. north of Oyon, and at which place is the lixiviation plant now treating the ores. Principal among Mr. Dunstan's properties are those at Raura and Pumahuain. The Raura mines, 22 km. north of Quichas, are now being connected with the latter place by a wagon road. The principal mine in the Raura region is the Esperanza, consisting of two mineralized fissures in an andesite intrusion. The vein is from 1 to 4 ft. wide, carrying galena, blende and various copper sulphides. The elevation of these mines is close to 17,000 ft.; they are surrounded by glaciers. The ores run from 5 to 15 per cent. copper, 15 to 50 per cent. lead and 30 to 100 oz. silver.

The Pumahuain region, comprised chiefly in a hill of that name, is cut by a large system of mineralized parallel fissures, striking northeast and southwest, varying in width from 1 to 3 ft., and carrying a pay streak of blende mixed with *pacos* and from 6 to 10 in. wide. The mines have been worked for the past 150 years and present the usual extensive and tortuous system of workings employed by the ancients. The formation is a metamorphosed sandstone. The ores average 30 to 60 oz. silver. For the purpose of treating these ores, several amalgamation or patio plants were installed, but these have for the most part been shut down for the last 40 years. Mining has also been carried on at Anamaray and Auquimarca, but the properties are now shut down.



ORE PICKING SHED, AGUAS CALIENTES MINE, NEAR CASAPALCA, PERU

Costs

It is extremely difficult to secure any reliable data covering costs of mining operations in Peru. The following are averages covering a wide range and have for the most part been secured from Peruvian mineowners:

TRANSPORTATION (Cents, gold, per ton mile):

Low and medium-grade ores	7.2
Mattes	9.1
High-grade ores, over $300 per ton	17.6
Packing (llamas and burros)	19 to 24

LABOR (Wages in gold):

Miners	$0.60 to $0.75
Outside men, ore sorters, etc.	0.40 to 0.50
Trammers and muckers	0.45 to 0.60
Boys	0.20 to 0.30
Laborers	0.35 to 0.50
Carpenters (native)	1.00 to 1.50
Timbermen (foreign)	1.50 to 3.50
Masons (native)	1.00 to 1.50

Skilled workmen are generally contract men.

The following mining costs are averages, and represent prices on contracts given to miners. Costs are in dollars gold per running meter.

(1) Fissure veins in Dacite, country rock tight, vein gangue quartz, breaking well to hanging wall.

Drifts, 6½x5 ft	$8.00 to $9.50
Crosscuts, 6½x5 ft	18.00 to 30.00
Raises, 4x5 ft	6.00 to 7.00
Winzes, 4½x5 ft., moderate depth	7.00 to 8.00
Shafts, 5½x9 ft., including timber and pumping, to 200 ft.	90.00 to 130.00

(2) Contact vein 100 ft. wide, decomposed porphyry with pyrites and blende.

Drifts, 6½x5 ft	$5.50 to $7.00
Raises, 4x5 ft	4.00 to 6.00
Winzes, 4x5 ft., water heavy	6.50 to 9.00

(3) Fissure veins in diorite, vein gangue quartz and porphyry, breaks poorly, tramming distance 1500 ft.

Drifts, 6½x5 ft	$9.00 to $13.00
Drifts, 6½x5 ft., close grain trap intruded	16.00 to 18.00
Raises, 4x5 ft	7.00 to 9.00
Winzes, 4x5 ft., water moderate.	8.00 to 12.00
Stoping per block, 8x3x3 ft	5.00 to 7.00

(4) Wide fissures, 6 to 10 ft., in andesite, vein filling quartz, very tight and tough, ore chalcopyrite.

Drifts, 6½x 5ft	$22.00 to $30.00
Crosscuts	18.00 to 21.00
Raises, 4x5 ft	18.00 to 20.00

It should not be supposed from these figures that cheap mining is prevalent among large companies. The costs here given are contract rates, and therefore, do not include superintendence, nor costly management. In mining large orebodies where considerable timber is required, mining costs are extremely high, due to the high price of imported timber, and the exorbitant freight rates.

Duty on Diamonds for Drills

A controversy, involving nearly $1,000,000 worth of imports annually, has arisen between the Government and importers of miners' diamonds used extensively in the construction of drills. For many years it has been the practice of the Treasury Department to admit the diamonds duty free, under the provision in the tariff for "miners' diamonds, not set." The Government now comes forward and insists that, as the diamonds are advanced in value by splitting or cutting, they should be classified under paragraph 445 of the law, which specifies duty at the rate of 10 per cent. To determine the correctness of the Government's action in returning the stones for duty, a test case has been brought by the Sullivan Machinery Company, Chicago. Hearings have been held before the Board of United States General Appraisers.

Machine Drills for Stoping—I

A Discussion of the Relative Merits of Piston and Air-hammer Drills. Suggested Improvements in Design and Practice. Speed Is Essential

BY EUSTACE M. WESTON*

Facts are always of more interest than opinions. I have, I am afraid, few new experimental facts to bring forward, and this paper must be considered merely as an attempt to collect and bring up to date our knowledge of this stoping problem, and to furnish material for discussion. In a former paper I advocated the use of higher air pressures and expressed my belief in the capabilities of small drills from the 2¾-in. size down. I also contended that three 2¾-in. drills worked with the same air pressure would do more work than two 3¼-in. drills, even in large stopes. This was generally denied. I believe the experiment was tried by S. H. Ford, at the Meyer & Charlton mine, and the result was that it was found better and cheaper to run with two 2¾-in. machines than with two 3¼-in. machines. Six holes per shift are now drilled with each machine.

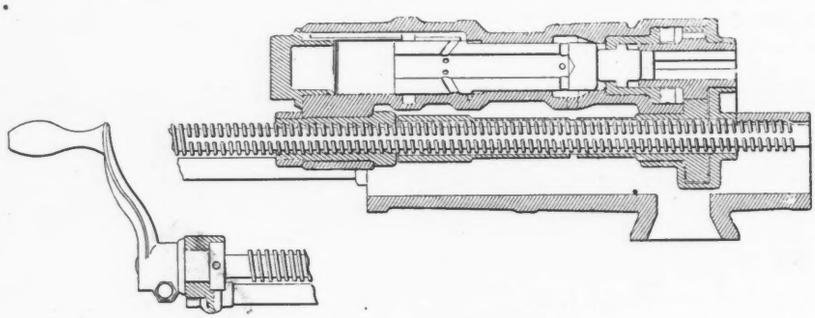


FIG. 1. LEYNER ROCK TERRIER DRILL.

If small drills of any type are to be a success in South Africa and to compete with hand labor, or replace it, one white man must supervise three or more; or by using the highest practicable air pressures, the rate of drilling must be so increased that it will pay to employ one white man alone with each machine. At most mines on the Rand, to displace hand labor with small machines, with the present compressor power and pipe lines, would spell disaster. Generally, small air drills have been condemned on past performances, though good results have been claimed in certain cases. The piston drill has done good work on the Crown Deep, the Geldenhuis Estate, and the Jumpers mine, and others, and the Gordon drill has had success at Randfontein, Kleinfontein, and other mines.

It is urged against the present types of small piston machines, that maintenance costs are as high or higher than large machines, owing to the endeavor to reduce weight at the cost of strength; that operating costs are but little different from those of large machines, as the miner in the past grumbled at being asked to look after more than two of them; that power costs came out the same as with large drills, because in small stopes a greater footage of drilling must be done to break the same tonnage of rock as would be required in large stopes. Costs are stated to be as high, or higher, than with hand labor, on the average, though it is conceded, that in soft ground at the Jumpers, the Geldenhuis Estate, No. 3 level, the Nourse mines, and at other properties, they may show an apparent economy.

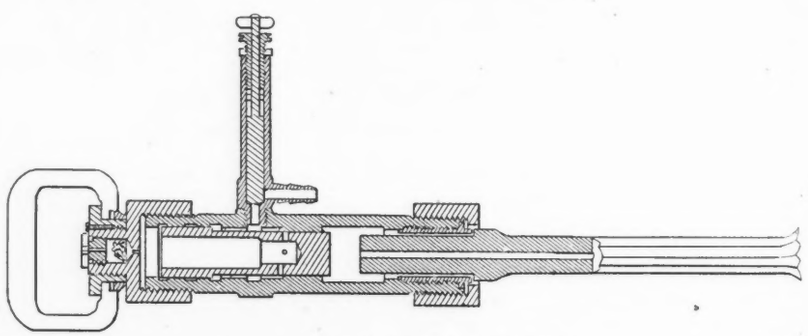


FIG. 2. MURPHY AIR-HAMMER DRILL.

Causes of Failure of Small Stope Drills

To me, there seem to have been various reasons for the failure of small drills in the past in many mines. Apart from the hinderances to good work, touched upon in a former paper, the chief reason was that the running of small drills in narrow stopes calls for more skill, and what is perhaps more important, harder work, more running about, and closer supervision than running two large drills in large stopes. Hence, under the conditions prevailing before the strike last June, it was considered almost a disgrace to run small machines. It was hardly likely that good miners would bother with them, when they could earn more money sitting down comfortably watching two machines at work in a large stope. They preferred often to throw the small machines down the slope. The machines were thus very soon handed over to the tender mercies of the inefficient and the loafer. No one was told off to study their working, and effect needful improvements in their operation. Then again, many of the machines were poorly designed and made of poor material.

Messrs. Holman are now making an improved small drill of totally different design, so they will perhaps forgive me for saying that their old 2½-in. tappet machine was about as bad a machine as could be made. I worked three of them for a year, and perhaps an account of some of their ways of breaking down may be of value.

The machine had a taper chuck, in which the drill tightened itself and had to be knocked out with a drift pin. The drill bits used in them had to be tempered hard on the corresponding tapered shank. This made them brittle and they were always breaking in or near the chuck. If the drills were not sufficiently hardened, they burred up or twisted on the end and could not be taken out. Sometimes the chucks themselves split, owing to poor metal. The worst was, however, that the bits were always sticking tight in the chuck. It was a common thing to have one stick fast just as a hole was to be finished at the end of a shift. It was im-

*Manager, Rand Collieries, Ltd. (Gold Section), Brakpan, South Africa.

Note—Abstract of an article, entitled "Notes on Small Stope Drills," that appeared in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa, for November, 1907. Some of the cuts in this article are taken from the article "Stope Drills," by J. Orr that appeared in the *Proceedings* of the Transvaal Institute of Mechanical Engineers, Jan. 1, 1908.

possible to use them at all without liners of tin, which the rock-drill fitter made for us, or which we cut out of old oil tins; but even with these I have spent hours trying to extract a drill. I have lit fires of candle ends and candle boxes in the stope to heat the chuck and have, even in desperation, blown out a drill end with a detonator and a shaving of gelatine. Both springs and ratchet were of bad steel and constantly broke. The cradles broke at the neck of the seat. It was almost impossible to keep the valve chest packed tight, and we often had to stop and repack it with a time card. When U-bolt chucks were obtained, the U-bolt was too weak and was always breaking, and the pads, or keys, were too soft, and always wearing out.

With all these drawbacks, and only moderate air pressures, these machines could drill well. They broke half a fathom each, per shift, in average Main Reef Leader ground on the 1000-ft. level. All these defects could have been easily remedied, and I consider it nonsense to say that a machine designed to work in 38-in. stopes, cannot be built to stand up to the work, even in the hardest rock.

My quarrel with the manufacturers of small piston drills is that they do not seem to know what they want, or what the mines want. Are the machines they sell today, one-man or two-men machines? If one-man machines, why not arrange them so that one man can run them? If two-men machines, what is the sense of cutting down a pound's weight here, and another there, and weakening the machine to the breaking point? Surely, they must know that a machine weighing 140 lb. is practically just as easy for two natives to handle as their machines of 90 and 100 lb., and can drill faster, and costs less for repairs.

Until recently, the 2¼-in. small drill was the standard small stope drill all over America, and is still used largely in development. The drill is worked by one man, with perhaps occasional assistance in rigging up, and theoretically, there is no reason why a small drill cannot be employed as economically as a large one; for, if the parts are smaller, the stresses met with are also reduced.

Method of Drilling Holes in Small Stopes

Two systems of work can be employed in narrow stopes. It has generally been denied that holes over 5 ft. long can be economically employed in small stopes 42 in. wide. Indeed, some appear to believe that 48 in. is the limit in width for stoping economically with machines. This I know to be a mistake, as we employed holes up to 7 ft. long, and yet kept a stoping width of 38 or 40 in. This method involves the use of 2½-in. to 2¾-in. machines, and two natives to a machine, with one white man supervising three machines. Four would be too many in ordinary situations.

In stopes where the reef itself is 30 or 36 in. wide, I think this method of stoping with good air pressures and working the stope, as previously described, can be made the most economical known, especially if the 2¾-in. Konomax drill with decreased air consumption be found suitable and can be employed. The machine used can easily be made as solid and heavy as necessary, and the repair bill can be kept down. One white man can supervise three machines, even with a shifting labor supply, if he takes the trouble to teach his natives, and to explain what is required of them, and why it is required. I have always found the Kafir as intelligent as the Chinese, if pains were taken to instruct him. When two or three leading natives quit, I always had spanner boys competent to take their places and thus always had skilled boys under me.

The steel used in average ground would be: Starter, 18 in. long, star bit, 2 in. diameter; second, 36 in. long, star bit 1¾ in. diameter; third, chisel or star bit, 1⅛-in. or 1¼-in. steel, 1½-in. bit, 4 ft. 6 in. long; fourth, chisel bit, 1-in. steel, 6 ft. long, 1¼-in. bit; fifth, chisel bit, ⅞-in. steel, 1-in. bit, 7 ft. 6 in. long. In hard ground, sizes of bits would be ⅛ in. or ¼ in. larger all round, and the final steel would be 1 in. diameter with a 1⅛-in. bit.

To employ such long steel requires greater skill, and even then stope widths in certain ground would tend to be too high; but the width should always be easily kept below 42 in., which recently was given as the hand-stope widths on the Main Reef Leader in a group of mines. In heavy ground, requiring timbering, it is, of course, an impossible method. It is sometimes forgotten that shoveling should be 6d. per ton cheaper in a stope 40 in. wide than in one 30 in. wide. The excess widths of machine stoping are generally caused by large blocks falling out of foot or hanging wall, and these cost very little to stack, or roll down out of the way.

The other system calls for the use of the one-man machine proper; such machines must be made as light as possible. They may in the future be used in two ways. It may be found economical to run with one white man, gaining increased efficiency and less maintenance costs to make up for higher labor charges. The number of feet that such a machine must bore per shift, to allow for the paying for the labor of a white miner, and to make costs compare favorably with those of hand stoping, can easily be worked out for each individual case.

In considering whether this can be done, we must remember that records made in the shallower levels of the Geldenhuis Estate and Jumpers mines are no criterion of what can be accomplished in the hardest reef of the deeper levels. This also, of course, applies to hammer drill performances at Randfontein and Kleinfontein.

The Necessity for Small Drills on the Rand

One-man drills, run either by natives with four or more in charge of one white, or perhaps with one white per machine, drilling short holes in stopes of minimum width, are undoubtedly needed to break much of the thin, rich reef on the Rand. When long holes are drilled one set-up per shift will generally suffice, inasmuch as five or six holes, 6 to 7 ft. long, can be bored from one bar, if the stope be properly benched and the bar properly rigged up, as previously described.

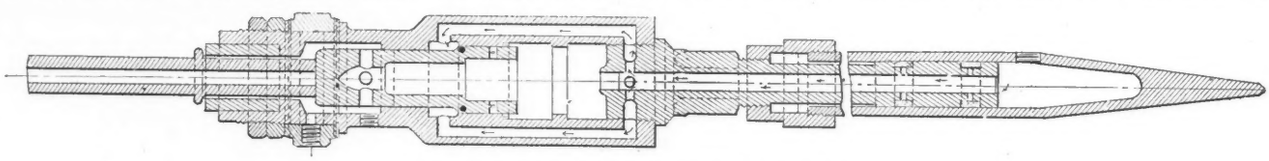


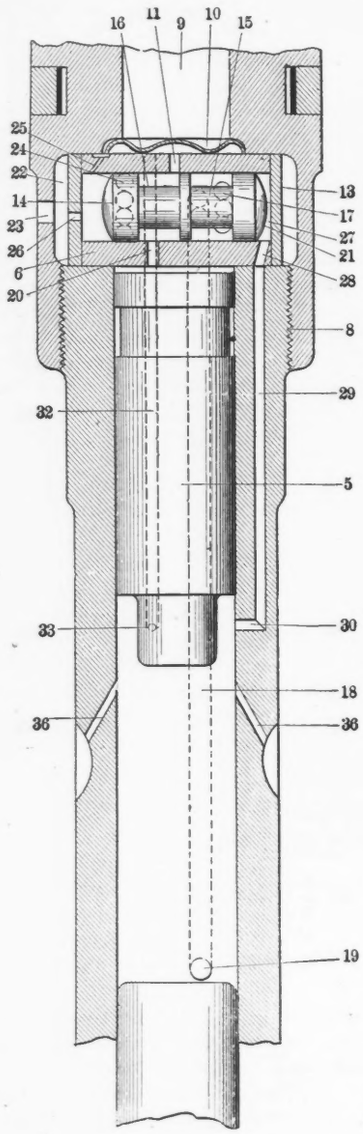
FIG. 3. HARDSOCG WONDER AIR-HAMMER DRILL

The problem of taking down and rigging up again, becomes important with one-man drills. A miner, who is going to bore ten 3-ft. or 4-ft. holes, must rig up three or four times. Even with a 3-in. bar and a clamp and arm arranged, as in the Gordon drill, this takes time. A miner in charge of such machines should be provided with a selection of spare bars of different lengths, and can then set up fresh bars ready for his workers to move to, while his machines are at work. A change from one bench to another can then be made with only 10 minutes' delay. This matter is often neglected with big machines.

The battle of types between the various small drills is only beginning, and there are yet no definite results to base comparisons on. The question of the ultimate supremacy of the piston or the hammer type for work on these fields remains to be solved.

The Air-hammer Drills

The great feature of mining work in America has been the rise and development of the small pneumatic-hammer drill. It has displaced the small 2¼-in. piston



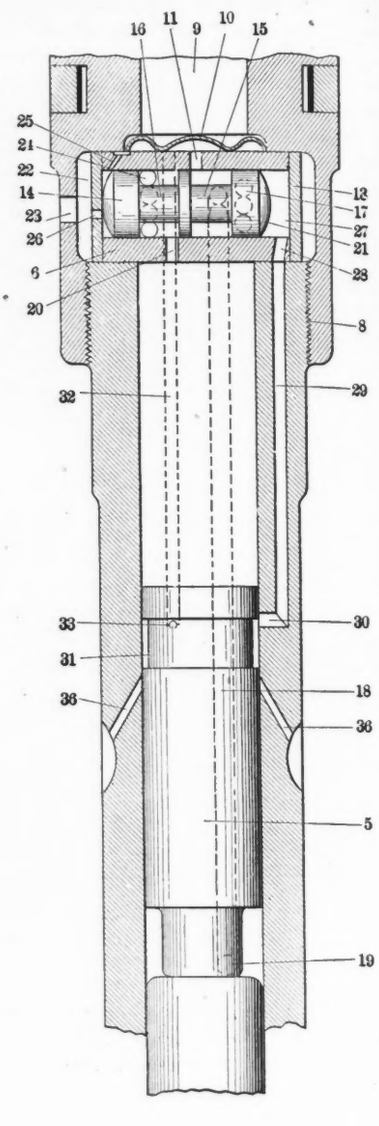
VALVE ON FORWARD STROKE

machine to a great extent in stoping work in America and also in shaft sinking. In England record footages in shafts, sunk in limestone, have already been recorded by their use.

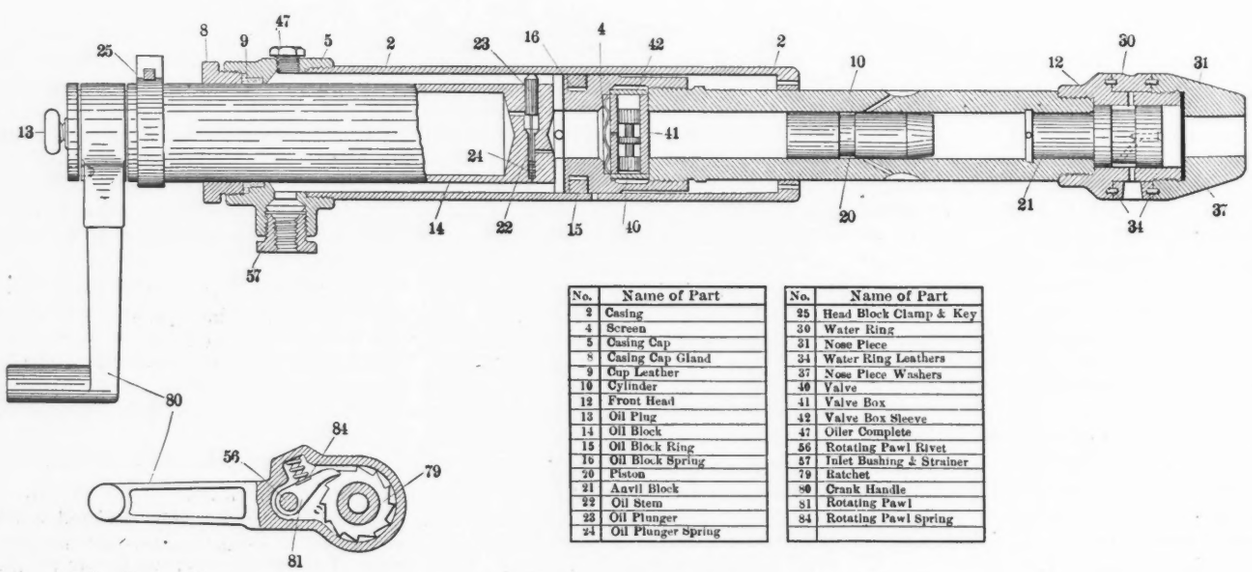
Hammer drills may roughly be divided into two main classes, viz., those having separate valves, and those not having separate valves. In the valveless type the differential piston, or hammer, itself acts as the valve. Machines of this class are the Little Imp, the Hardsocg Wonder, the Murphy, the Sinclair, and the Leyner Rock Terrier drills (Fig. 1). The large Leyner machine is worked by a piston valve, the Little Jap by an axial valve, and the Gordon drill by a piston valve at right angles to the piston.

The air-hammer drills may be again divided into those that employ an anvil block to take up and transmit the blow of the hammer, and those that strike a direct blow on the shank of the steel. The Leyner Rock Terrier and the Gordon drill, belong to the first class; nearly all the rest strike the blow directly on the steel itself. Hammer drills may also be divided into short-stroke and long-stroke machines.

The favorite small machines in America are those without a separate valve, and which strike the steel directly. Their advantage consists in their extreme simplicity and lightness. They transmit the force of this blow more directly to the rock, having to overcome the inertia of the drill steel only; but they work generally on a short stroke and rely on a high velocity to give momentum to the hammer, which is light, as otherwise trouble might occur through the burring up of the shank of the drill bit. Besides, as they are often held in the hand, heavy blows would cause too much jar on the operator's muscles. The pistons can be expected to last a long time without undue leakage, as they are ground to fit



VALVE ON RETURN STROKE



No.	Name of Part
2	Casing
4	Screen
5	Casing Cap
8	Casing Cap Gland
9	Cup Leather
10	Cylinder
12	Front Head
13	Oil Plug
14	Oil Block
15	Oil Block Ring
16	Oil Block Spring
20	Piston
21	Anvil Block
22	Oil Stem
23	Oil Plunger
24	Oil Plunger Spring

No.	Name of Part
25	Head Block Clamp & Key
30	Water Ring
31	Nose Piece
34	Water Ring Leathers
37	Nose Piece Washers
40	Valve
41	Valve Box
42	Valve Box Sleeve
47	Oiler Complete
56	Rotating Pawl Rivet
57	Inlet Bushing & Strainer
79	Ratchet
80	Crank Handle
81	Rotating Pawl
84	Rotating Pawl Spring

FIG. 4. GORDON AIR-HAMMER DRILL

into a case-hardened cylinder; but, if grit gets in, leakage losses may be developed quickly.

In the valve machines of small size trouble has been caused, and doubtless will be caused despite the use of strainers, by small pieces of scale coming from air pipes, or by grit, getting into the machine, when it is lying in the stope; this grit or scale chokes the narrow parts or causes the valves to stick. Valve-moved, anvil-block machines are heavier and more complicated, but they have a better valve motion, and air can, if necessary, be used expansively. They do not bur up the end of the steel, but they require anvil blocks of a special quality of steel and breakage of parts is frequent.

Differences are also found in the manner in which rotation is effected. The large Leyner machine uses a ratchet and rifle bar like those of piston drills. The Leyner Rock Terrier drill uses a positive-geared rotation, worked off the feed-screw. The Gordon machine has a rotation worked by a central spindle ending in a handle and ratchet at the rear of the machine. Most of the other drills are pivoted on the handle or air feed, and are oscillated or revolved by a handle fastened to the front of the machine; this handle sometimes contains the air valve. Fig. 2 shows a typical make of a simple American hammer drill and its air feed attachment.

Success of Air-hammer Drills in America

Nearly all these makes of drills are working with success in America, and most of them have been in South Africa without success. The big Leyner drill is at present, I believe, at work on only two mines, the Jupiter and the Consolidated Main Reef. The Rock Terrier drill is not at work anywhere here.

What are the causes of failure? Why is a machine that is a success elsewhere a failure here on the Rand? In trying to answer this question I must borrow largely from current American technical literature. The working air pressures on the Rand are only 40 to 75 lb. per sq.in. These machines were all made to be operated by air at 90 to 100 lb. pressure. Mr. Leyner, the pioneer of hammer drills, is reported to have said that it is impossible to get satisfactory work from a hammer drill with air pressures below 70 pounds.

The reason of the failure of these hammer drills is now obvious, apart from certain other defects. They were all provided with a light piston weighing ½ lb. to 1 lb., with a very short stroke, and they relied for the kinetic energy of the blow $\left(\text{a product of mass and velocity, } \frac{MV^2}{2},\right)$ on the high velocity caused by the high air pressures, (1) to overcome the inertia of the steel; and, (2) to cut the rock; they also relied on striking 1500 to 2000 blows per minute.

On the Witwatersrand the rock requires more cutting, and owing to the low pressure, the velocity of the hammer and the number of blows per minute were reduced; hence they could not drill well. Then all the other drill operators, except the Gordon people, have been troubled with the supply of suitable hollow steel, and even the Gordon people have had some trouble, I believe. Leyner at first had to use welded bits that were always breaking, and the steel sent from America for his small machine and also for the Hardsocg Wonder machine, Fig. 3, though reported to be satisfactory there, was almost useless here. Neither of these machines is being used here at present, partly for this cause, though both makers would, I think, have to lengthen the stroke on their machines before they are adapted for use here.

Besides, no machine tried except the water Leyner had any suitable water-feed attachment for use with hollow steel, and a hammer drill is useless here without water being led through hollow steel to the cutting edge of the drill bit. Fig. 4 is a sketch drawing showing the arrangement of the front head, water-feed device and anvil block of the Gordon drill; 2 is the cylinder wall, 20 is the striking hammer, 21 is the anvil block, 12 is the front head in one piece (this has to take up and resist the blows of the hammer should the steel not do so); 30 is a hollow water ring secured by the ring and a lock nut. Air is exhausted through the hollow drill steel and meets the water coming from the ring along the hole in the anvil block 21, and carries it down the hollow steel.

The designers of the Gordon drill were in a position to understand the bearing of the previous failures on the solution of the problem. They decided to use a stroke, 8 to 8½ in. long, and a piston weighing about 2 lb., and to strike a heavier blow, relying more on the mass than on the velocity (which after all must be increased four times to double the kinetic energy) for the cutting force of the blow. Without any anvil block such a blow might have given trouble by burring up the steel, and in their system of water feed an anvil block is a necessity, hence an anvil block is used. Heavy blows are, however, much severer on the steel, on the anvil block, and on the machine itself, especially in hard ground. It is claimed that suitable steel to withstand these stresses has been procured.

The makers of the Murphy drill were not discouraged by their first failure, and they claim also to have produced a water-feed machine of simpler construction than the Gordon drill, and one that will bore twice as rapidly as their former machine did at 60-lb. pressure.

When I speak of drilling at 40 or 50 lb., I recognize that it does not pay to work any machine, either of the hammer or the piston type, at that pressure, and I believe that air pressures will have to be increased if any type is to be a permanent success.

In turning to a comparison of hammer and piston drills, we must now ask why the hammer drill beats the 2¼-in. piston drill stoping in America with air pressures of 90 or 100 pounds.

Drill Practice at Cripple Creek

In Cripple Creek, the rock is mostly fairly hard granite intersected by phonolite dikes. This rock cuts better than our quartzites and conglomerates. A miner experienced there told me that the general difference of gage between piston-drill steels was nearer ⅛ in. than the ¼ in. used in hard ground here on the Rand.

All holes drilled in stopes there are up-holes, only slightly inclined from the vertical. The law does not bother about dust production. The miners manage to wear respirators, or die. Then, even at 100 lb. pressure, the hammer drill does not drill as fast as the piston drill; but owing to the introduction of the air feed as shown in Fig. 3, no arm bar or clamp is required for these hammer drills, in which the diameter of the hammer is 2 in. No time is lost in rigging up, as the tail of the air feed is placed on a board in the stope filling, and drilling is started within 15 minutes of entering the stope.

It is well known that only about 50 per cent. of actual working time is employed in drilling with piston drills; the rest of the time is taken up in rigging and adjusting machines, and in changing drill bits, etc. In drilling under these conditions with hammer drills most of the time is saved, hence better work is done. In an 8-hour shift, 40 ft. is bored by a 2-in. Murphy drill, against 25 ft. with a 2¼-in. piston drill, even though it does not drill as rapidly while running. Repairs are cheaper than with piston drills, being something like half. The air consumption is less per foot drilled, but not much less per shift, for the hammer drill is working more continuously. Solid steel is used in these up-holes, hence in this class of work the cost of drill steel is about the same as with piston drills.

On the Witwatersrand the rock is harder to cut, and heavier blows must be delivered on hollow steel which is itself more expensive in first cost, cost of upkeep, and cost of sharpening, than the solid steel used in most piston machines. No welding can, I think, be permitted. The hammer drill cannot be used with the air feed alone, as all stopes are inclined, though it might be possible to work steep stopes at Randfontein and elsewhere with sand filling by this method; but it is doubtful if the water feeds would not give trouble. Here then, as in a piston machine, a bar with some kind of arm and clamp must be employed, hence not much time is saved here in this respect, nor is much time saved in changing bits.

A water feed with its great advantage and corresponding expense must be used, and nearly all the holes will be bored a few degrees on each side of the horizontal.

As far as I can learn from others, and from experience in mining with one of the smaller types of hammer drill which are held in the hand, some of the disadvantages of this type are that as the holes drilled have very little clearance, great care must be taken in alinement, or the hole will get out of truth and be lost. Even in drilling up-holes the drills are likely to stick, and in America several patent and special tools are employed to release such drills. Here in drilling down-holes any temporary stoppage of the water, due to grit choking cocks, or passages, is almost sure to result in a stuck drill. The same trouble is caused by a soft drill burring up on the ends, choking the central hollow core, and wedging itself by burring up its ends. The chief troubles so far have been due to breakages, and this, of course, may be overcome by improved design and better material. However, the types of big Leyner drill at work here cost £6 to £7 per month for repairs.

The advantages proved for the hammer drill, with water feed, are a very fair drilling speed in ground of moderate hardness, capability to be handled by one operator, the ability to drill at the same rate of speed in any direction, ability to work in small stopes, and absence of dust trouble. Pillars can be more easily cut out and stopes run more parallel to the levels, thus allowing rock to be shot always toward box holes.

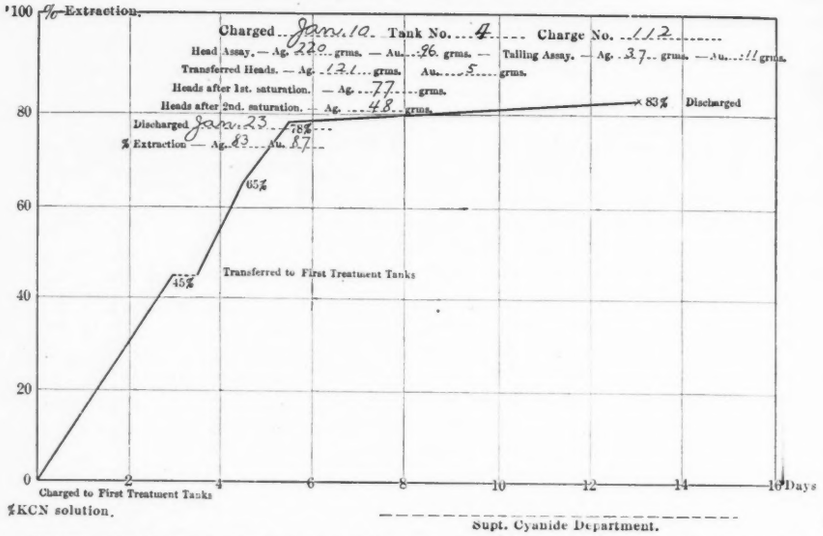
I am certain that this type of rock drill with its few wearing parts is going to be largely used here, and I am pleased that the advantages of passing water to the cutting edge of the drill bit down hollow steel are likely to be demonstrated. The Leyner people in America, claim to be beating 3¼-in. piston drills in the footage drilled per shift, and I am convinced that any success this machine and others may have had is due to the aid thus given to boring progress. If this system can be successfully applied to piston-operated machines, a great increase in efficiency will at once be shown.

Mines near Rosita, Silver Cliff and Ilse, Colo., were formerly large producers of lead. The Bassick mine was opened on a chimney consisting of an agglomerate of andesite and other volcanic material impregnated with galena and other sulphides. The chimney was roughly elliptical, 100 by 20 ft. to 100 by 30 ft., and was followed to depth of 1400 ft. without losing the ore. The Bull Domingo mine was opened on a similar chimney. The Terrible mine, at Ilse, was opened on a wide porphyry dike, impregnated with crystals of cerussite. These mines were important producers of lead from about 1882 to 1890.

Sand-treatment Chart and Record

The accompanying illustration shows the form and arrangement of a chart employed by the Guanajuato Mining and Milling Company for keeping records of the progress of the cyanide treatment of silver-bearing sands. Bernard MacDonald, author of the article on "Cyanidation of Silver Ores at Guanajuato," which appeared in a recent issue of the JOURNAL, states that a chart of this kind is used for keeping the record of each sand charge, the curve showing graphically the progress of the treatment in percentages and elapsed time.

SAND TREATMENT CHART AND RECORD



RECORD CHART USED BY THE GUANAJUATO CONSOLIDATED MINING AND MILLING COMPANY

Mining in Cornwall

SPECIAL CORRESPONDENCE

Metalliferous mining, except as regards iron, is carried on in England only on a small scale. Cornwall is the most active district and tin the principal metal worked for. During 1906 the value of metallic minerals won in Cornwall and Devon amounted to only £780,907, in which tin ore figured as £713,184. Earthy minerals for the same period were valued at £708,404, the largest item being china clay valued at £429,970. Mining has been carried on for centuries and the district is well known to contain mineralized veins of great value and extent. The fact, however, remains that mining in Cornwall meets with but little success from a shareholder's point of view. According to a recent number of the *Records* of the West Country Chamber of Mines only two mines are shown on the dividend list, namely, East Pool & Agar United and Dolcoath, though it is fair to say that the report covered only a short period. A short time back one heard a good deal about the revival of mining in Cornwall when the high prices of metals made the reopening of mines at home attractive. Unfortunately very little success has so far rewarded this effort. Insufficiency of working capital or failure to work on a large enough scale are reasons which may be given for this melancholy state of things.

Among the mines which have been reopened in recent years, is the Clitters United, situated in North Cornwall. These mines produce tin, wolfram, copper and arsenic, and, when prices were high, made profits. During the latter part of 1907 the company got into financial difficulties, partly owing to the heavy fall in the price of metals, and partly in consequence of pumping troubles. Fresh capital is now being asked for by the directors. The affairs of this mine are a good illustration of the poor financial direction of Cornish mining enterprises. It appears that in the early part of 1907 the directors distributed a dividend out of the profit made when metals were exceptionally high, and at a time when the condition of the property was clearly one that required further funds for equipment and development. This is the sort of finance that kills Cornish mining.

According to *The Iron and Coal Trades Review,* March 20, 1908, it is reported that manganese of good quality has been found about seventy miles from Karachi in the Lus Beyla State, India. A small quantity of the material has already been shipped to the United Kingdom to ascertain its real market value, and a syndicate has been formed to work the mining concession which has been obtained. A light railway or tramway will possibly be laid from the foot of the Pubb Hills to the seaboard for the conveyance of the ore.

Mineral Production of New York

By D. H. Newland*

Substantial progress was made during 1907 in many departments of the mineral industry, and although conditions in some lines were not so prosperous as they had been in previous years, the general record may be regarded with satisfaction. The census of production that has been conducted for the present and preceding issues of this report covers over 30 different materials mined or quarried in the State; the total value of the output returned for 1907 amounted to $37,427,405, showing a small advance over the corresponding total for 1906, which was $37,118,430, the largest recorded up to that time. When compared with other years the status of the industry in 1907 appears in even more favorable light, as the value of the production in 1905 was $35,470,987 and in 1904 only $28,812,595. Within the four years for which returns have been collected, there has thus been a gain of 30 per cent. in the mineral production of the State.

These valuations, it may be noted, are based on materials in elementary or first marketable form, so that they actually represent only a small part of the aggregates contributed each year by the mineral industry in general. The metallurgical and chemical products classed as mineral are among the largest items of local manufactures.

Iron

Iron mining has undergone uninterrupted expansion during the last few years. The output for 1907 amounted to 1,018,013 long tons and exceeded that of any previous year since 1890. There were 13 mines under exploitation, or two more than in 1906, when the production was 905,367 tons. Several additional mines are under development preliminary to active work. The Clinton ore belt was the center of special interest, and large tracts of land in Wayne and Cayuga counties were acquired by companies with a view to mining operations. The Fair Haven Iron Company began shipments from this region for the first time in 1907. The Adirondack region also shared in the activity. The Benson mines, in St. Lawrence county, and the Cheever mine, near Port Henry, were reopened, while the deposits of titaniferous ores at Lake Sanford received attention; their operation is postponed only for the want of railroad facilities, which are planned for the near future. With a return of the iron market to normal conditions, it may be expected that the iron-ore production of New York will soon develop beyond all proportions of the past.

Clay Materials

The clay materials reported in 1907 represented an aggregate value of $12,688,868. There was a decrease of $1,266,432 from the amount returned for the preceding year, due to the smaller output and market values of the building materials. The combined output of brick, tile, fireproofing and terra cotta used for building purposes was valued at $8,909,392, as compared with $11,063,433 in 1906. The number of brick made was 1,366,842,000, of which 1,051,907,000 came from the Hudson river region. The decline in the output of building materials was counterbalanced to some degree by the gain in pottery manufactures, which were valued at $2,224,895, against a value of $1,795,008 for the preceding year. Of the 61 counties of the State, 43 were represented in the reports received in 1907 from the manufacturers of clay products.

Building and Other Stone

The quarries of New York contributed a value of $7,890,327, against $6,107,147 in 1906, showing an increase of about 20 per cent. and establishing a new record for these industries. The total was divided according to the various uses into: Building stone, $2,208,545; monumental stone, $162,359; curb and flag stone, $1,064,193; crushed stone, $2,812,998; other uses, $1,642,232. The output of slate, millstones and of limestone used in making hydraulic cement is not included in the totals. The marble industry was specially active in 1907, and the production, valued at $1,571,936, has probably never been exceeded in the State. The stone quarries are distributed among all the counties practically, while they yield nearly every kind of material for building, construction or ornamental purposes.

Cement

The companies manufacturing hydraulic cement reported for 1907 an output of 3,245,729 bbl., with a value of $2,971,820. The totals consist of 2,105,450 bbl. of portland cement, valued at $2,214,090, and 1,137,279 bbl. of natural rock cement, valued at $757,730. In the preceding year there were 4,114,939 bbl. produced, valued at $3,950,699, so that there was a loss for the year of 869,210 bbl. in quantity and $978,879 in value. The poor showing has been due largely to the unfavorable conditions that obtained in the natural-cement trade, which has shown a steady decline for several years.

Salt

The salt production of the State amounted to 9,657,543 bbl., as compared with 9,013,993 bbl. in 1906, thus continuing the progress that has for some time been a feature of the industry. The value of the output was $2,449,178, exceeding that of the previous year by $317,528. There were six counties represented in the returns, with Onondaga county in the lead, though its output consisted mostly of salt used for soda manufacture. Livingston county made the largest quantity of marketable grade, chiefly rock salt.

Gypsum

An aggregate of 323,323 short tons of gypsum was taken from the mines and quarries of the State in 1907, as compared with 262,486 short tons in 1906. The output has increased by over 100 per cent. within the last three years, due to the rapid development of the trade in wall plasters, stucco, etc., and to the use of gypsum in portland-cement manufacture. The value of the different materials was $1,038,355, as compared with $699,455 in 1906.

Petroleum and Natural Gas

The combined value of the petroleum and natural gas produced in the State in 1907 was $2,536,349, a small increase over the value reported for 1906, which was $2,487,674. The quantity of petroleum taken from the wells, estimated from receipts of pipe-line companies, was 1,052,324 bbl., valued at $1,736,335, or nearly the same as in 1906. The natural-gas production was valued at $800,014, as compared with $766,579 in 1906; the volume amounting to 3,052,145,000 cu.ft., against 3,007,086,000 cu.ft. in 1906. New discoveries of gas continue to be reported and the additional supplies thus made available have more than sufficed to maintain the rate of production.

Other Mineral Products

Pyrite—The mining of pyrite showed a notable advance during 1907, the output amounting to 49,978 long tons, which compares with 11,798 tons for 1906. The mineral is obtained in St. Lawrence county. A large amount of exploratory and development work has been done recently, with results that may lead to a further expansion of the industry. The product finds a ready sale for making sulphurous and sulphuric acids.

Talc—The talc mines near Gouverneur contributed in 1907 a production of 59,000 short tons, or a little less than in 1906. The value of the output was $501,500. The production is governed chiefly by the requirements of the paper trade and shows little tendency to fluctuate from year to year.

Garnet—Garnet for abrasive uses is obtained from the eastern Adirondacks. An output of 5709 short tons, valued at $174,800, was reported in 1907. The returns for the preceding year showed an output of 4729 short tons with a value of $159,298.

Graphite—The crystalline graphite mined in the Adirondacks amounted to 2,950,000 lb., valued at $106,951, against 2,811,582 lb., valued at $96,084, in 1906. Almost the whole quantity was taken from the mine at Graphite, Warren county, though many other companies have been engaged in the industry during the last few years.

*Assistant State geologist, Albany, N. Y.

Carbon Dioxide—A somewhat unusual industry not elsewhere represented in this country is that connected with the production of natural carbon dioxide, or carbonic acid gas, as it is generally known. The gas occurs in association with the mineral waters of Saratoga springs, and its collection and storage for use form an interesting, as well as important, industrial development. About 5,000,000 lb. of the gas is sold each year, chiefly to manufacturers of carbonated waters.

MINERAL PRODUCTION OF NEW YORK IN 1907.

Product.	Quantity.	Value.
Portland cement (bbl.)	2,108,450	$2,214,090
Natural rock cement (bbl.)	1,137,279	757,730
Clay building brick (M.)	1,366,842	7,424,294
Pottery		2,240,895
Other clay products		3,023,679
Crude clay (sh. tons)	3,927	6,163
Emery (sh. tons)	1,223	13,057
Feldspar and quartz (l. tons)	8,723	36,230
Garnet (sh. tons)	5,709	174,800
Glass sand (sh. tons)	1,200	1,380
Graphite (lb.)	2,950,000	106,951
Gypsum (sh. tons)	323,323	1,038,355
Iron ore (l. tons)	1,018,013	3,750,493
Millstones		21,806
Metallic paint (sh. tons)	5,269	59,521
Slate pigment (sh. tons)	620	3,700
Mineral waters (gal.)	8,000,000	1,000,000
Natural gas (1,000 cu.ft.)	3,052,145	800,014
Petroleum (bbl.)	1,052,324	1,736,335
Pyrite (l. tons)	49,978	162,430
Salt (bbl.)	9,657,542	2,449,178
Roofing slate (squares)	11,686	53,625
Slate manufactures		1,175
Sand-lime brick (M.)	16,610	109,677
Granite		195,900
Limestone		3,182,447
Marble		1,571,936
Sandstone		1,998,417
Trap		941,627
Talc (sh. tons)	59,000	501,500
Other materials (*a*)		1,850,000
Total value		$37,427,405

(*a*) Includes apatite, arsenical ore, carbon dioxide, diatomaceous earth, fullers earth, marl, and sand and gravel, exclusive of glass sand.

Petroleum in Spain

Three years ago, while improving a canal leading to a flour mill near Villamartin, Spain, the presence of petroleum was discovered, and a well was opened. At a short depth a lime rock was struck, which when broken by dynamite, laid bare a large mass of ozokerite.

In March, 1907, Louis J. Rosenberg, Consul at Seville, states, a company possessing about 7,000 acres was formed for the purpose of exploring, exploiting, and industrially treating the petroleum. A new well was begun and petroleum was extracted at the depth of only 8 meters. At a depth of 14 meters the quantity of hydrocarbon gas, given off by the well, was so great that the workmen were compelled to stop drilling in the usual way, and the exploration was continued by means of boring machines. At a depth of 74 meters, a considerable quantity of gas came to the surface, which gradually increased as work progressed until a depth of 79 meters was reached, when the pressure amounted to 80 lb. per sq.in. On Dec. 15, 1907, after the necessary safety appliances had been set up, a large flow of good petroleum was obtained. The petroleum was found to be extraordinarily rich in benzine and the lighter oils.

An Electromagnet for Testing the Suitability of an Ore for Magnetic Separation*

By L. H. L. Huddart

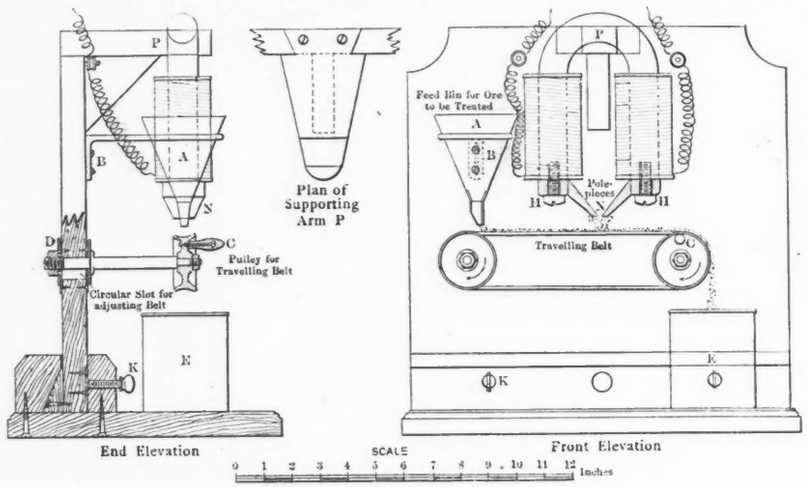
The accompanying sketch illustrates an apparatus that has been found to be convenient for the determination of the separation to be expected in treating an ore by means of a powerful magnet. The machine consists essentially of a 6-in. soft-iron electromagnet, with 1-in. core, fitted with brass bobbins wound with 18 B.w.g. copper wire. Two special pole pieces *N* are provided; they are slotted to allow of the adjustment of the air gap. The magnet is suspended from a bracket on a hardwood stand, the back of which is secured to the base by means of two pinching screws *K*. The arrangement shown in the sketch was designed to give a rigid, yet easily dismounted, attachment. Upon the same stand there is also mounted a copper hopper with a support slotted to allow of vertical adjustment. This hopper feeds on to an endless belt running on two grooved pulleys, one of which has a small handle, *C*. These pulleys have about ¾ in. adjustment in each direction, to permit of the belt being placed into the required position beneath the pole pieces.

After suitable reduction, the sample is put into the hopper *A*. The rate of feed to the belt depends upon the hight of the spout above it; in this manner the feed can be adjusted to some degree of nicety. The endless belt is driven by hand by means of the small handle *C*, and the ore travels slowly beneath the pole pieces. The distance of the belt below the poles can be varied by slackening the nuts *D*, which clamp to the back the small shafts upon which the pulleys run. A suitable distance is found by trial. The ore that is not picked up by the magnet is carried on and falls into the hopper *E*.

*Abstract of a paper in Bulletin No. 45, Institution of Mining and Metallurgy.

After running a short time, if there is much magnetic material present it will have to be removed from the pole pieces, which is conveniently done by placing a piece of stiff paper, or sheet copper, beneath the poles and switching off the current. The strength of the field is varied by loosening the screws *H*, and moving the pole pieces closer or farther apart, according to whether a stronger or weaker field is required.

The current may be supplied by a hand dynamo, off the mains, after a suitable resistance has been inserted, or by means of a secondary battery. Two cells do admirably. The battery is the most convenient, and, in a case, is portable; but, of course, it is only available when there is a source of current by which it can be charged from time to time. The sketch shows a form designed for use in the field, with a hand dynamo of 3 amp. at 10 volts and 300 r.p.m.



ELECTROMAGNET FOR TESTING ORE

Japanese Cement

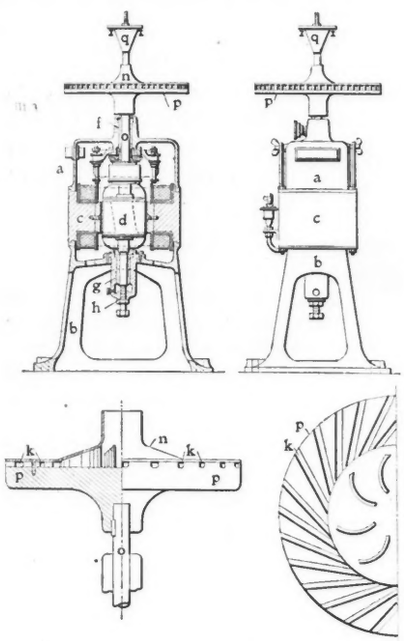
According to a recent Consular report, the total monthly output of cement in Japan, which was not more than 600,000 bbl. two or three years ago, is believed to have increased to about 1,300,000 bbl., the producing capacity of every cement company having been increased by 50 per cent. The importation of cement is now materially checked, the industry having been encouraged by the recent activity of water-power electric work, waterworks and other engineering work. On account of the present financial depression business activity has died away, however, and the cement companies newly promoted have delayed the construction of factories, while the older companies have reduced output and are now watching the progress of events.

Large timbers in a shaft will resist decay longer than small ones.

The Souchon Classifier

A new type of separator for the concentration of ores in dry state has recently been tested by a committee of the Société d' Encouragement pour l' Industrie' Nationale.[1] The machine depends for its operation upon the difference in the acceleration displayed by particles of different weight when projected into a resisting medium, as into the air. The classifier is now in use at the copper mines of La Fare, and El Cid Mining Company has arranged to install the machine on a large scale in its new mill at Ezcaray, Spain.

The classifier consists of a cast-iron frame, *a b*, inside of which is the vertical motor, *c d*. On the axle *O*, of this motor is fixed a horizontal, circular plate *p*.



SOUCHON DRY CENTRIFUGAL CLASSIFIER

Around the center of this plate are a number of paddles, and around the circumference a number of channels *k*, the arrangement of both of which is varied according to the kind or ore to be treated. Over the top of the plate spreads a hood *n*, with the feed opening at its center, designed to restrict the centrifugal flow of the materials to the channels *k*.

The motor is regulated by two rheostats. It is exceedingly important to maintain the speed of the motor within very narrow limits inasmuch as the distance to which a particle with a given weight will be projected is a function of the velocity. As long as the speed remains constant, the particles of equal weight will all fall into a zone at a certain distance from the machine. With grains of 2mm. diameter, which is the coarsest size that can be treated satisfactorily on this machine, and with a speed of 800 to 1200 r.p.m., the maximum distance of projection will be less than 10 meters. Experiment is needed in each case to determine the speed best suited to give a satisfactory separation and, at the same time, to obviate an unnecessarily large floor space for the operation.

Each concentric zone contains all the grains of a given weight, whether metallic ore or gangue, whence it follows that the usual gangue minerals will be found in larger pieces than the accompanying metallic minerals in the same zone and can be separated by screening. The proper mesh for the screen to be used with each zone also has to be determined experimentally. The air vibrations set up by the revolving machine are found to interfere somewhat with the realization of theoretical results, and certain zones of middling products are the result; these can then be treated a second time.

The concentric zones of ore are swept up, each by itself, by a revolving framework of 16 wooden arms, to each of which are attached the requisite number of scrapers. The ore falls through the floor into appropriate bins.

At the plant at La Fare the original ore carries 0.54 per cent. of valuable metal, and the concentrate is enriched to 2.50 per cent. The amount of dust developed by the operation is a drawback, but by careful adjustment of the central paddles the proportion of dust has been reduced to 20 per cent. It is stated that a satisfactory separation can be accomplished with material as small as 0.2-mm. diameter.

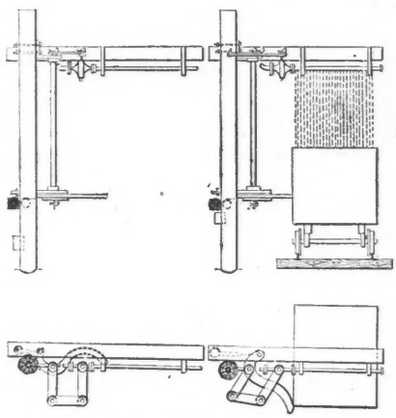
[1] *Bull.* de la Soc. d'Encouragement, Feb., 1908, p. 222.

Coal-dust Sprinkling[1]

An apparatus recently installed in the Heydt colliery at Herne, Rhenish Westphalia, for the purpose of automatically sprinkling the loaded coal cars with water, is illustrated in the accompanying figure.

To a cap of the entry timbering is attached a pipe 80 cm. long by 35 mm. in diameter, one side being drilled full of small holes. The outer end of the pipe is closed, and the inner end is connected, through a turn cock, to the water main. A vertical rod, free to turn, is bracketed against the post of the same timber set. At its upper end this rod is connected by lever and links to the turn cock, and at its lower end it carries a lever which projects out over the nearer rail. While a car is passing, the cock is held open and a counterweight closes it as soon as the car is past.

In the main haulage entry of another mine, in which dust was particularly abundant, electric locomotives were employed, and it was found that the necessarily frequent sprinklings caused corrosion of the trolley wire and made the rails too slippery for the locomotives. The management thought to overcome this difficulty by sprinkling the rooms and entries with a solution of five parts of magnesium chloride in three parts of water. The strongly hydroscopic magnesium chloride was expected to maintain the dust in such a damp condition that it could not be blown about. To sprinkle 1 meter of double-tracked entry required 7 or 8 liters of solution, and cost, including labor, 0.25 mark. In such places as had been sprinkled, the ground remained



DEVICE FOR SPRINKLING COAL CARS

damp for a long time, but the fine dust lay so loosely on top as to blow around as freely as before, and the experiment was not repeated.

A more improved way is to put a sprinkling jet over the position occupied by the first car following the locomotive. The stop cock is placed where the locomotive driver can reach it to turn the water on just as he is starting the trip. The boy at the rear turns it off, and thus the rails on which the locomotive must pull remain dry.

[1] *Glückauf*, March 7, 1908, p. 354.

Cleaning Motors

A method for cleaning electric motors which are required in dusty places, as, for example, in a briquette plant, an anthracite breaker, or similar places, has been employed with satisfactory results at a German coal mine. It consists in blowing the motor periodically with a jet of compressed air.

A 1-in. pipe is laid to the vicinity of the motor. This is terminated with about 3 meters of rubber hose, to the end of which is fitted a nozzle with a small orifice. The motor is cleaned with a blast of air at 90 lb. pressure once in eight hours.

Deputy Consul-General J. J. Slechta reports that the demand for cement in Brazil is constantly increasing. Imports in 1906 increased 100 per cent. over the preceding year, the supply coming chiefly from Germany, Belgium, Great Britain and France.

The Economy of Modern Colliery Ventilation

High-speed Centrifugal Fans Afford Seven Times the Efficiency of Screw-type Ventilators and Effect an Annual Saving of $5000

BY J. R. ROBINSON*

In the early part of the nineteenth century, England and Wales experienced a number of disastrous mine explosions which shocked the public, and caused many engineers to endeavor to find some means whereby the frequency of such accidents might be averted. Among those who investigated was a young Welshman, Humphrey Davy, a chemist in the town of Gloucester, who conceived the idea of a lamp that would burn in an explosive mixture of gases without igniting the gas. Mr. Davy had no thought of removing the gas from the mine, nor of so diluting it that it would be rendered harmless, but proposed that his lamp should burn in any mixture of marsh gas and air in which there was enough air to feed the flame. It was generally conceded at that time that the open candles then in use in the mines had been the cause of the explosions.

It was proposed by Davy to exclude the gas from the lamp. He had discovered during the course of his experiments that a flame would burn in an explosive mixture of air and marsh gas without igniting the gas, if the flame was surrounded by a wire gauze of fine mesh. Through his experiments he determined that the gas would burn in the flame, and would not pass through the gauze to the dangerous atmosphere on the outside. With this knowledge he prepared a lamp that would admit no air except such as passed through the wire gauze of fine mesh. His first lamp was a crude affair, but it had the elements of a successful lamp for use in a gaseous mine. Sir Humphry Davy's lamp was such an important invention, and was received with such enthusiasm throughout Great Britain that he was created a baronet for this useful invention.

Dangers of a Safety Lamp

All safety lamps used in mines are but mechanical improvements of the Davy lamp, using the same general principles. As this lamp came into common use, explosions were less frequent than they formerly were. It is well to remember, however, that the safety lamp is only safe so long as there is sufficient air in the mine atmosphere to feed the flame, and keep the lamp cool. Whenever the gas is in large quantities, and the lamp is unable to get proper circulation of air through the fine meshes of the gauze, the latter becomes heated, and under such conditions the gauze may be raised to such a temperature that the hot wires will ignite the gas surrounding them and cause an explosion.

With the knowledge we have of the properties of mine air, the inflammable gases, the noxious and poisonous gases and the charging of the air with minute particles of coal dust, it is evident that all mines should have a large volume of fresh air in circulation throughout the entire workings. Not only in the air courses and haulage roads, but at the working faces. It seems to be the general impression that if the air measurements show a large volume passing through the air courses, then the mine is properly ventilated. This impression is often erroneous, and is generally misleading. A mine may have a large volume of air in circulation, but it may be circulated under a low pressure, or is short circuited, and does not reach the working faces; its useful effect is then diminished for the purpose of ventilation, since the air currents do not reach the noxious gases to mix with them, thus diluting and carrying them out of the mine. The miner is rarely at work in the direct air current. He is usually employed at the working face in the stagnant air and among the noxious gases, and if the air current is not carried close to him, his life is in danger, not only from the inflammable gases, but from those that are poisonous.

Mine managers and superintendents are generally familiar with these facts, but almost every mine disaster on record can be traced to some matter of neglect. When the conditions providing safety for the miner are not met by the management, the reason may generally be attributed to the question of cost. Sometimes the management out of mere cupidity, and filled with that gambling instinct that takes chances, hoping that the chances will be favorable, will neglect to do what is necessary to insure proper ventilation; and sometimes men who have little knowledge of mining, are in charge of the operations, and through ignorance of the laws governing the flow of air currents, fail to provide the necessary apparatus, or having it, neglect to make use of it to the best advantage.

The Power Required for Ventilation

It is not my purpose to introduce a mass of formula that may be unintelligible to the average reader, but it will be necessary to give some formulas to show the reason why adequate ventilation is frequently not provided. The power required to drive air through a given mine increases as the cube of the volume, provided no change is made in the air courses: Let V represent volume of air, in cu.ft. of air per min.; let P represent pressure of air as represented by inches in water-gage; let W represent pressure in ft.-lb. performed on the air; then $W = V \times P \times 5.2$, as 5.21 lb. is the pressure of air per sq.ft. as represented by 1 inch of water-gage. When reduced to horse-power, the formula then becomes

$$h.p. = \frac{V \times P \times 5.2}{33{,}000}.$$

To illustrate this formula, suppose a mine passing 100,000 cu.ft. of air per min. against a 2.3-in. water-gage. The work performed in passing the quantity of air at the given pressure, will be in terms of

$$h.p. = \frac{100{,}000 \times 2.3 \times 5.2}{33{,}000},$$

which is equal to 36.24 h.p. Now the pressure of air increases as the square of the volume, so that if we desire to increase the volume of air from 100,000 cu.ft. of air per min. in the above instance to 200,000 cu.ft. of air per min., we will require eight times as much power as to produce the 100,000 cu.ft. of air per min., as in the first case, for having doubled the velocity, the water-gage will have increased from 2.3 in. to four times 2.3, or 9.2 in. Now substituting in our second formula, we have

$$h.p. = \frac{200\,000 \times 9.2 \times 5.2}{33{,}000},$$

which equals 289.92 h.p., which is eight times 36.24 h.p., the amount of power required in the first example. It will be seen that to get the increased 100,000 cu.ft. of air, it will require 252.68 h.p., whereas in the first example only 36.24 h.p. was required, so that the second 100,000 cu.ft. of air required seven times as much power to pass it through the mine as the first 100,000 cubic feet.

When we consider that the installation of a ventilator, capable of producing 289 h.p. in the air, would cost eight times as much as a ventilator producing 36 h.p. in the air, we can understand why the management hesitates to purchase such expensive apparatus. Furthermore, if a horse-power in the most favored coal regions at the mine costs about $50 per year, then to increase the ventilation as above cited from 100,000 cu.ft. of air per min. to 200,000 cu.ft. of air per min., would cost for power alone, about $12,634 per year. This annual cost at many

*Scottdale, Pennsylvania.

mines would be a serious consideration. What, then, would be required to get the necessary amount of air without making such an outlay of money in running expense? In most mines the quantity of air could be doubled without increasing the power eight times, by cleaning up, enlarging and increasing the number of air courses, thereby reducing the velocity of air and consequently the pressure. The pressure is the great absorber of power, and it is well to bear in mind that for a given amount of air, a certain pressure will be necessary to propel the air through the mine, and regardless of what form of ventilator is used, this pressure will be the same.

It is a common but mistaken belief among mining men, that one favored form of ventilator will propel the current through a mine at a less pressure than another ventilator. This fallacy should not be entertained by any mine manager. The conditions in the mine determine the pressure or water-gage against which the air must circulate, and the ventilator has nothing to do with the condition of the mine.

Early Methods of Ventilation

Many different methods of ventilation were tried in mines in the early times. Before mechanical ventilating apparatus had become cheap enough and economical enough to make its use profitable in mining, falling bodies of water and steam jets and furnaces were used. It is obvious that falling bodies of water could be used in but few mines, and even where such conditions prevailed, a very large amount of air could not be obtained by such a method.

Steam jets were discovered to be very wasteful, and did not procure the necessary ventilation; it became necessary, therefore, to have some better manner of ventilation than either falling bodies of water or steam jets. The furnace came into use, and has to a large extent been employed in all coal mining fields. The furnace is placed at the bottom of the shaft, where a large body of coal can be kept burning. The heated air from the furnace ascends the shaft, and draws the cooler air through the mine. The amount of draft obtained by a furnace is obviously proportioned to the degree of warmth the furnace will impart to the air passing through it, and this in turn is proportioned to the hight of the stack. As an example, assume a furnace stack to be 150 ft. deep; barometer at 30 in.; temperature of atmosphere 60 deg. F.; then

$$\frac{13.141 \times 30}{461 + 60} \times 150 = 11.30 \text{ lb.},$$

also,

$$\frac{13.141 \times 30}{461 + 220} \times 150 = 8.69 \text{ lb.}$$

The difference 2.61 lb. per sq.ft. represents the force active to produce ventilation. This pressure represents about ½-in. water-gage. Now 30,000 cu.ft. of air per min. at ½-in. water-gage is 2.37 h.p. in the air. This example perhaps, represents the average of furnace ventilation, and from it we can readily see that furnace ventilation is not adequate to meet the requirements of the present, besides being dangerous where gas is encountered.

Fan Ventilation Most Satisfactory

The best method of ventilation yet discovered is fan ventilation. There are two distinct types of fan; the screw-type and the centrifugal. The screw-type is made similar to the propeller of a steamship and consists essentially of a wheel built upon a shaft with a spider keyed to it, and arms, with vanes attached, radiating from the spider. These vanes are usually of flat steel plates, and taper from the widest part at the rim toward the center of the wheel; in some cases, the vanes instead of being flat, are cupped to suit the notion of the manufacturer. These vanes are usually set at an angle of about 60 deg. with a plane passing through their center and lying in an element of the shaft. They are placed in various ways. The casing is usually a band of steel, circular and concentric with the shaft. The action of this fan is rotary, and each vane cuts out a definite portion of air, and passes it through the fan in a direction parallel with the shaft on which the fan rotates. This style of fan passes the air through, parallel with the axis of rotation, and so differs from centrifugal fans, which discharge all their air at right angles to the axis of rotation. Screw-type fans are useful for development work, and for drift mines where the airways are short and the pressure is not high.

The cost of installing a screw-type fan is low and it can be easily moved from place to place. A ventilator of this kind will not work against a high pressure, hence it is not used in large mines requiring a considerable volume of air at a high pressure. Its mechanical efficiency is variously rated, and it is difficult to give even approximate figures, as the mechanical efficiency depends so much upon the pressure against which the fan works.

A test of one of these fans, 7 ft. in diameter, that came under my personal observation, resulted in less than 10 per cent. mechanical efficiency, and the fan that replaced it, a centrifugal fan working on the same airway and under practically the same mine conditions, gave a mechanical efficiency of 74 per cent.

Centrifugal Fans

The centrifugal fan consists essentially of a wheel built upon a shaft with arms that carry vanes to the circumference of the wheel. The vanes may be flat or curved and may be continuous from the shaft to the rim of the wheel, or may only be small, flat paddles at the rim of the wheel. The air is caused to pass through the fan by the rotation of the wheel, the vanes displacing the air away from the shaft by centrifugal action. This displacement of the air by the fan's rotation causes a reduction of pressure in the center of the wheel, which permits the air from the outside to flow into the center of the wheel where the pressure has been reduced, and as the action is continuous, the air rushes through the wheel and is thrown off from the tips of the vanes. The wheel is made to rotate in a casing which is built close to the revolving ends of the vanes, and is usually made in a spiral manner, so that the spiral comes close to the tips of the vanes at the point of cut-off, and recedes from this point to the discharging orifice. The inlet orifice is usualy on both ends, and is about ½ to 2/3 the diameter of the wheel.

Centrifugal fans are of many types, all of them more or less developments from the old Guibal type. The mechanical efficiency of these centrifugal fans ranges from the old paddle-wheel types that give about 20 per cent. mechanical efficiency under ordinary mining conditions, up to the latest type at 80 to 90 per cent. mechanical efficiency.

It was the custom in the early history of bituminous coal mining in America to drive an entry known as the main entry in the direction that would go through the entire field; an air course for the return air was driven parallel to this main haulway. This applied to drift operations, as that was the only form of mining employed in the early days. It was the custom to lift the track from the return airways, and when falls occurred they were generally allowed to choke up the return air course, greatly to the injury of the ventilation. The above described method of ventilating a mine required a great number of doors and limited the current to one return airway.

Modern Methods of Ventilation

In recent practice there is an air course on each side of the main haulage-way, and the system of over-casts is used instead of doors. With this system of over-casts the air may be split up into any desired number of currents, and all brought to one return current close to the fan. This splitting of the current reduces the velocity of the air, and hence the friction, and is therefore much to be desired, provided, of course, that the current, if weak, is not split to such an extent that the air in any portion of the mine becomes stagnant. It is regarded as good practice to have the current in all splits at a velocity of not less than 200 ft. per minute.

Force *vs.* Exhaust Ventilation

Slope mines having the field all on one side of the mine mouth are ventilated much the same as drift mines. Shaft mines are, however, laid out to ventilate from the fan shaft as a center, and this fact permits shaft mines to have a decided

advantage over drift mines for purposes of ventilation. Most shaft mines are now laid out with four main air courses diverging from the bottom of the fan shaft. These four air courses permit large volumes of air to be passed at a low velocity, and hence a low pressure or water-gage.

The question is often asked, should a mine be ventilated by a force current, or an exhaust current, or in other words, should the mine be ventilated above the atmospheric pressure, or below it? The force current keeps the mine above atmospheric pressure, and the exhaust keeps it below atmospheric pressure. Which is the correct method? If the seam is pitching where the outlet is higher than the inlet, the current should be such as to take advantage of this condition. The difference between the temperature of the air in the mine and the air outside would require a reversible current, so that the current used in summer could be reversed during winter. In a mine working a level seam, little advantage can be taken of temperature for reversing the current, but for gaseous mines there is a certain controversy as to the advisability of using a force current, the argument being advanced by those favoring exhaust currents, that the force current keeps the gases back in the face and in the old workings, so that should anything cause a cessation of the current, the gas would flow out into the workings with probably disastrous effect. This applies to barometric changes as well as falls in entries or old workings. When we consider that few mines are working on a pressure above 3-in. water-gage, or about 0.1 lb. per sq. ft., and that the pressure on the gases in the coal seam is probably many pounds to the square foot, this reasoning does not seem conclusive against the force current.

Influence of Barometer Changes on Ventilation

An example of the probable results of barometric disturbance in connection with mine ventilation is given in the Engineering and Mining Journal for June 1, 1907, page 1053: "It is therefore important to consider to what extent or in what degree is this effect operative? In other words, what is the practical significance of a stated fall of barometer with reference to producing an explosive condition of the mine air, waiving the actual occurrence of an explosion? In answering this question, it is necessary to state that barometric changes are gradual, a fall of 0.1 in. in from three to five hours is a rapid fall of barometric pressure, and does not occur, except at infrequent intervals. I will assume for the sake of illustration an extremely bad case such as could not occur in any justifiable mining practice. Say there are ten acres of abandoned workings standing, and full of pure marsh gas, in a 6-ft. seam, at an elevation of about 10,000 ft. above sea level; and the barometer falls from 20 in. to 19.9 in. in three hours. Approximately the gas set free in this case is $\frac{10\,(43{,}560 \times 6)}{200\,(3 \times 60)} =$ 72.6 cu.ft. per min. during the time in which the barometer is falling. This quantity of gas is the amount in excess of what is given off regularly. To show the proportion of this increase of gas due to a sudden fall of barometer, I will assume the velocity of the air-current passing in the airway skirting the old workings is, say, 600 ft. per min., and the airway has a sectional area of 50 sq.ft., giving a circulation of $600 \times 50 = 30{,}000$ cu.ft. of air per min. If this current carries ordinarily 2 per cent. of gas, the mine is producing 600 cu.ft. regularly, which is increased to 672 cu.ft. during the fall of barometer. The increase in the percentage of gas in the air current is, in this extreme case, only from 2 to 2¼ per cent., which increase could not be detected on the flame of a Davy lamp."

"In usual mining practice today, any dangerous goaves are so far ventilated as to prevent large accumulations of gas in them, and as a consequence, what gas is thrown out from such places owing to a fall of barometer or other cause, is not pure marsh gas, or even feeder gas, but air containing perhaps a high percentage of gas. Under such normal working conditions, assuming an acre of abandoned workings in a 6-ft. seam and a fall of barometer from 29.1 to 29 in., the volume of air and gas thrown off is

$$\frac{43{,}560 \times 6}{290\,(3 \times 60)} = 5$$

cu.ft. per min. Assuming this contains as high as 20 per cent. of gas, which is not likely, the increase of percentage of gas in the air current of 30,000 cu.ft. of air per min., assumed previously, is only from 2 to 2.003 per cent., an inappreciable increase. The actual gas given off in this case is increased only 1 cu.ft. for 600 cu.ft. regularly produced."

Some of our best engineers are now erecting their fans for a force current, owing largely to the simplicity of the machinery and surroundings of a fan, and also because they want a return current to come out of the haulage-way, or up the hoisting shaft, so that the hoisting or haulage-way may be kept free from ice in the winter season. It may be held that the inlet in front of the fan would freeze up in the winter season, but this is provided for by turning the exhaust steam from the fan engine to the inlet in front of the fan during freezing weather.

Great care should be taken to have large airways, and keep them clear and free from débris. A small airway may seem to be very economical at the beginning of the mine, but it may prove to be very expensive before the mine is finished. Here is an example of the expensiveness of a small airway: A certain mine had an airway 72 sq.ft. cross-section, and 2 miles long, which was used as a haulage-way, and the return airway was 60 sq.ft. cross-section, with the length of 1¼ miles. The mine was using 90,000 cu.ft. of air per min. with a 2-in. water-gage, which was ample under ordinary conditions, but owing to the development of the gaseous territory, the mine was pronounced unsafe by the mine inspector unless 200,000 cu.ft. of air per min. should be passed through. Now 90,000 cu.ft. of air per min. at a 2-in. water-gage represents a force of 29 h.p. in the air; and 200,000 cu.ft. at a 9.8-in. water-gage represents 309 h.p. This increase of power was necessary to obtain the increased amount of air. In this instance the airway could have been 100 cu.ft. cross-section, and would have reduced the velocity to 2000 ft. per min. for a volume of 200,000 cu.ft., besides reducing the pressure more than one-half. The reader can calculate for himself some such instance as that related above, which comes under his own observation, and he will be astonished at the folly of small airways.

The Meaning of Fan Efficiency

As the centrifugal fan has practically succeeded all forms of ventilators, and has proved beyond a doubt that it is the most successful and economical fan for ventilation, I will confine my remarks almost exclusively to this type of machine. There are three forms of efficiency that must be considered in all fans, and the value of the fan depends largely upon its ability to give that efficiency, which is most valuable for the particular mine on which the fan is to operate.

The mechanical efficiency is to be considered first. Mechanical efficiency is the relation the useful work performed by the fan, bears to the power required to propel the fan. The manometric efficiency is of second importance. Manometric efficiency is the relation which the depression caused by the fan, is to the theoretic depression which the fan would make if it were a perfect machine, and working against a closed airway. The volumetric efficiency is the third to be considered. The volumetric efficiency is the relation which the volume of air discharged by the fan, bears to the volume or cubic contents of the fan, taken the number of times of rotation during the given interval of measurement.

A fan may be high in one of these efficiencies and low in the others. For instance, a fan may produce a large volume of air at a very low pressure, and be excellent in volumetric efficiency, and yet be low in manometric efficiency and mechanical efficiency. In fact, fans high in mechanical efficiency are usually high in manometric efficiency, and almost all fans high in mechanical efficiency, when working under favorable conditions, are low in volumetric efficiency.

A fan may be high in volumetric efficiency and low in mechanical efficiency, and also low in manometric efficiency;

these conditions all depend on the construction of the fan, and the conditions under which it works. The mechanical efficiency of the fan may be determined if the volume of air passing through the mine is known, and the pressure (water-gage) reading is taken at the same time the air reading is taken, together with the indicated power of the motor (either steam engine or electric motor) when resolved into foot pounds.

The manometric efficiency may be determined if the tangential speed of the fan is known, and the actual pressure as read by the water-gage. The volumetric efficiency may be determined if the rotations of the fan are known, and the volume of air discharged is known for the same interval. A fan may have high manometric efficiency, and not be useful for mine ventilation; for instance, a cupola fan can produce the required pressure for a mine and not give any volume worth consideration. A fan may have a large volumetric efficiency under favorable conditions, and yet under unfavorable conditions be unable to produce pressure, and hence be a poor fan for mine ventilation.

Method for Testing a Fan

Testing a fan is a proceeding requiring a considerable degree of skill and care. It is customary in making an anemometer test to organize the force so that each main airway shall have two men allotted, one to take the anemometer readings, and one to hold the watch and light and call the time. The time of reading should be one minute, two minutes, three minutes, or any number of minutes that may be agreed upon. It is difficult, however, to hold the anemometer in a swift air current longer than three minutes, and for this reason this is usually the time limit. The readings should be taken about 100 ft. away from the fan in a drift, or about 100 ft. from the bottom of the shaft in a shaft mine, and should be taken at a place where the section of the airway is nearly uniform and as smooth as possible, and not close to any turns, where the air may be deflected into eddies.

It is well to adopt a schedule of readings at intervals of fifteen or twenty minutes so that the velocity of air, the water-gage, the speed of motor, and temperature and barometer may be taken at exactly the same time as the motive power applied is indicated. With large fans it is customary to use steam engines, and the indicator is used to ascertain the motive power applied. In the usual tests at coal mines, the barometer and temperature are neglected, as not having sufficient bearing to warrant the calculations necessary to apply them to the test. It is essential that a certain time be set for each and every reading, that they may be all taken simultaneously, and at least three readings should be taken at varying speeds of the fan. It is preferable to test under such speeds as may be employed under the conditions which the mine may require. To get proper readings of the water-gage, it should be so placed that it will record the pressure of the air immediately in front of the fan, and in the full current where there is no possibility of an eddy in the current.

To obtain the proper position it is necessary to pipe from the water-gage in the engine room to a place in front of the fan where the air current is in one body. The end of this pipe should be from 10 to 25 ft. from the periphery of the fan and should be bent so the air current will flow directly into it. If it is hung down a shaft, the pipe should be curved returning upward, and have a small hole in the lower side of the curve to drain the moisture that would collect and form a water seal, if there were no drainage. This water seal will destroy the true reading if the pipe is not drained.

The indicator should be operated by a competent engineer who understands the theory of steam consumption of a steam engine as well as the mere knowledge of the operating of a steam-engine indicator, as there may be defects in the valve gear that the indicator will show to the practiced eye, which might be overlooked by the novice. It should be borne in mind that the engine or motor is having its efficiency tested along with the fan, and any loss of efficiency in the engine or motor will reflect on the fan. In taking the readings it is well to begin with the even hour, and allow five minutes to each party detailed to take the various readings to measure the air velocity, the water-gage and to take the indicator diagrams. The fan should be maintained at a constant speed during this interval. At the end of the first five minutes, the fan should be accelerated to a desired speed during the succeeding ten minutes, and beginning with the even quarter hour, be maintained at a constant speed during the succeeding five minutes, so the various readings may be taken at the desired speed of the fan. At the end of this five minutes, the fan may be accelerated again, and other readings made at intervals of one quarter hour, and as long as may be desired.

The accompanying table gives a test taken by the Westmoreland Coal Company, of Irwin, Penn., which is a fair sample of the manner of taking the various readings on a 20-ft. centrifugal fan driven by a steam engine:

The table shows the general method of a test for practical purposes, where boiler test is omitted, and also the variation of the barometer. For all practical purposes, the above test is sufficient, and shows the mine engineer where he can practice economy on his ventilation, through the mechanical efficiency of his fan.

The Economy of Providing a Modern Fan

It is estimated by economists that a great portion of our wealth is obtained by the immense immigration coming to us, and this immigration is coming largely to our mines. If as the economists tell us, it costs us $1000 to bring a child to manhood, and we can get the immigrant for nothing, it is still wise on our part to care for him. The best care a mineowner can give his miners is good ventilation. It is regarded by some of our largest coal companies as good practice to produce an indicated horse-power for $50 per year, and with this as a basis for calculation, I will consider the cost of ventilation with efficient and inefficient apparatus.

Most of the old style paddle-wheel and screw-propeller fans are working with less than 20 per cent. mechanical efficiency, while the latest high-grade speed fans are working above 60 per cent. mechanical efficiency, and in the great majority of cases, are working with a mechanical efficiency of between 70 and 80 per cent. Assuming that the old-style fan is working at 20 per cent. mechanical efficiency, and the new high-speed fan at 60 per cent. efficiency, also that 100,000 cu.ft. of air per min. at a 2-in. water-gage is required, the horse-power in air

$$\frac{100{,}000 \times 2 \times 5\ 2}{33{,}000} = 31.51\ h.p.$$

Now 31.51 h.p. is 20 per cent. of 157 h.p.; 31.51 h.p. is 60 per cent. of 52.51 h.p. It will be seen that 157.55 h.p. will be required to drive the old-style fan to produce the required ventilation, while only 52.51 h.p. will be required to drive the new high-speed fan. Thus the new high-speed fan will save the difference between 157.55 h.p. and 52.51 h.p., or 105.04 h.p. Now, as one horse-power is produced at a cost of $50 per year, it follows that the saving effected with the new high-speed fan is $105{:}04 \times 50 = \$5252$ per year. This amount of money will install a fan to produce the required 100,000 cu.ft. of air per min. at a 2-in. water-gage, under the worst conditions likely to be found, and would therefore return to the owner the entire value of the fan each year.

FAN TEST AT WESTMORELAND SHAFT, IRWIN, PENN.

Time. P. M.	Rev. per Min.	Split No. 1.		Split No. 2.		Split No. 3		Volume.	W. G.	H.P. in Air.	H.P. Ind.	Mech. Eff.
		Area.	Vel.	Area.	Vel.	Area.	Vel.					
4:00	100	50	1428	58	1593	44	500	195,134	2.40	73.8	114	65
4:15	132	50	2245	58	2200	44	740	286,791	4.20	190	265	71.7
4:30	150	50	2853	58	2383	44	822	335,914	5.10	272	344	79.0
4:45	150	50	2800	58	2463	44	833	337,171	5.20	276	360	77.7

Colliery Notes, Observations and Comments

Practical Hints Gathered from Experience and from the Study of Problems Peculiar to Bituminous and Anthracite Coal Mining

DEVELOPMENT AND MANAGEMENT

Dust accumulations are more dangerous in winter than in the summer time, because the atmosphere entering the mine is at a lower temperature during the cold months, and the condensation which takes place on the roof and sides of the mine is greater in summer and tends to keep the dust damp.

An anthracite mine in eastern Pennsylvania some time ago discarded a 1⅞-in. iron rope which had given five years and two months of continuous service. The shaft where it was used was 960 ft. deep; 369,048 cars of coal, or 1,300,000 tons, were raised by this rope, besides timber, supplies and men.

The United States Geological Survey reports the presence of great peat bogs in southern Georgia and Florida. Similar bogs are also said to exist in nearly every State in the Union and particularly in those that border on the ocean. When coal and wood have been exhausted as a fuel these bogs may be developed.

For underground haulage roads, points and crossings made of cast steel are cheaper and more convenient than those manufactured from the same section as the rail; when worn out, the former can be easily replaced and may be always kept in stock, which is not equally true of points and crossings of the latter type.

When planning a mine generator station, be sure and see that there is room enough back of the switchboard so that workmen making repairs or alterations will not come in contact with live parts. Stationary motors should be placed in inclosures by themselves, and ventilated with intake air. Wherever possible, cables should be taken down the down-cast shaft.

Hoisting and haulage ropes should be uncoiled carefully to avoid kinking, as the cable is not apt to coil symmetrically on its drum if kinking once takes place. Ropes should be stored on timbers in a dry place. Broken wires should be bent backward and forward until they break off at the point where they disappear into the rope; this is better than shearing them off.

A liberal supply of automatic greasers should be used on mine cars and some method should be employed for collecting the drippings from the cars; with this saving, it is possible to effect a considerable lessening of cost. An inexpensive method of effecting this saving is to place a shallow wooden trough, about 3 or 4 in. deep and the same width, where the bearings run each side of and parallel with the rails; this trough will catch the drippings when the cars start out after being oiled.

Modern practice asserts that the frequent repairing of stretches of mine road, where small falls or dislocations have occurred, or where the roof or sides have become bad through the action of water or slips, is false economy. It is claimed that much expense, time and temper may be saved by putting up a short length of arch or by using brickwork in the form of side walls, with iron girders placed over the top and covered with broken timber. Either of these arrangements would probably last a lifetime, and prove cheaper by half than repeatedly repairing or patching the road.

An economical way of protecting the sides of a main road from crumbling or weathering action, due to variations of temperature, is to utilize the stone obtained from the roads to build walls along the sides of the gangway. They should be built with ordinary mortar, and when dry should be lime washed to exclude moisture and prevent the disintegration of the lime used as a binder. Girders may be supported by these side walls and the roof also made safe. This also minimizes the use of timber. In dry dusty mines it largely prevents the settling of dust on the rough and uneven sides of the road and affords a safety zone in the event of an explosion.

All props set in mine roads should be placed at certain fixed distances from the outside rail of the road and as nearly as possible in a straight line. Where iron on steel girders are used the caps should be placed between the top of the props and the girders, and at right angles to them, as this tends to increase the life of the props and prevents the girders from tilting. Where the roof is weak, girders should be set with wood between them and the roof; this method will prevent the top falling out around the girders, and furthermore, distributes the weight evenly. Girders should also be braced with props from one to the other to prevent their twisting out.

The man placed in charge of an electric coal-cutting machine should be a practical miner; he should provide himself with a safety lamp with which to detect gas, if it is present. If he finds gas in any considerable quantity he should at once stop the machine and switch off the current until the gas has been removed. He should examine his trailing cable at frequent intervals to see that the insulation has not been injured by abrasion. Trailing cables should be attached to the machine before being connected with the gate-end switches. All terminals should be fitted out with flame-tight casings, while motor casings should also be flame-tight and strong enough to withstand an ordinary fall of roof.

Rubble stone for hoisting-engine foundations while cheap is the least satisfactory of all foundations as it is apt to be weakened by cracking. Stone foundations for hoisting engines should never be built with lime mortar as the engine vibration is certain to disintegrate a foundation thus laid. Good portland cement should always be used. Natural cements, while superior to lime, are not as strong as portland cement, and besides being slower to set, are apt to crumble if long exposed to the weather. Concrete foundations are cheapest and most satisfactory in the end. Brick gives good results for small foundations. Cut-stone foundations may be made much cheaper by using a facing and capping of cut-stone and a filling of rubble. This is an especially good method to use when constructing the masonry used about a hoisting-engine drum. For hoisting-engine foundations a concrete mixture of one part cement, three parts sand and six or seven parts stone gives good results.

Electric cables for power and lighting in mines should be properly hung in a safe position at least 12 in. from cars passing along the roads. Where practicable, cables should be fixed on opposite sides of the road, except in cases where signal and telephone wires are conducted along one side of the gangway, then they should not be hung on the same side as the signal and telephone wires. Where the roof is good and bars or girders are not required, holes should be bored in the roof at suitable distances apart and tee irons should be driven in plugs in the holes while the cables are supported by pieces of rubber or some other non-conductor from each end of the tee iron. If the cables are hung on props, they are apt to be knocked out by runaway cars getting off the track. Where girders are used, the tee irons can be made in the form of clamps and clamped around the two lower flanges of the girder while the cables are hung on the lower end. No circuit should be over 500 yd. without a double-pole switch, both for testing and safety. A generous supply of switches should be used so that the current can be immediately cut off in case of accident and the danger from naked wires minimized.

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Contents

The Price for Copper in 1907

After the appearance of the official reports of the copper-mining companies of Lake Superior, which with but one or two exceptions inform their stockholders with much detail respecting the results of operations, it has been our custom to make a comparison between the price received by them for their output of copper and the average of the daily quotations as reported in the ENGINEERING AND MINING JOURNAL. For 1907 it has not been possible to make so complete a comparison as in previous years, because at the end of the year almost all of the companies had larger or smaller quantities of unsold copper, which was to a considerable extent disposed of during the following January and February. Under this circumstance the Lake companies have two methods of informing their stockholders respecting their receipts. Certain companies, including the Adventure, Allouez, Centennial and Quincy report simply the total amount received for the production of copper in 1907, irrespective of when it was sold. The other companies report separately the production in 1907, the sales in 1907, and the stock on hand at the end of the year. Obviously it is only the reports of the latter companies which give us a fair basis for comparison. The results of the 10 companies so reporting are given in the accompanying table.

SALES BY LAKE COMPANIES IN 1907.

Company.	Production.	Stock Dec. 31, 1907.	Copper Sold, 1907.	Receipts for Copper Sold, 1907.	Average Price Per Lb. of Copper Sold.
Baltic	16,704,868	2,501,579	14,203,289	$2,556,592	18.00 c.
Champion	16,489,436	2,469,316	14,020,120	2,523,622	18.00
Franklin	4,401,248	2,020,070	2,381,178	460,466	19.34
Isle Royale	2,667,608	313,410	2,354,198	418,310	17.77
Michigan	2,665,404	824,758	1,840,646	298,884	16.24
Mohawk	10,107,266	4,516,220	5,591,046	984,080	17.60
Osceola	14,134,753	3,054,543	11,080,210	2,012,843	18.17
Tamarack	11,078,604	4,147,207	6,931,397	1,274,043	18.38
Tri-mountain	8,190,711	1,226,571	6,964,140	1,253,545	18.00
Victoria	1,207,237	257,436	949,801	183,152	19.28
Totals	87,647,135	21,331,110	66,316,025	$11,965,537	18.043 c.

It appears that these 10 companies, producing 87,647,135 lb. of copper, had on hand at the end of the year 21,331,110 lb., or 24.337 per cent. of their output during the year. They sold in 1907 the quantity of 66,316,025 lb., for which they received $11,965,537, or an average of 18.043c. per lb. The total production of the Lake Superior mines in 1907 will appear in the final statistics to be a little more than 220,000,000 pounds.

The average of the daily quotations of Lake copper in the ENGINEERING AND MINING JOURNAL in 1907 was 20.661c. The failure of the producing companies to come nearer to the quotational average is explained by the remarkable experiences of 1907. During the first five months of the year the price for copper was high, the average for that period being upward of 25c. per lb. Most of the companies sold considerably ahead, many contracts running into July, so that these companies continued to receive high prices for their product even after the market had started decidedly downward. However, stocks in some cases had begun to accumulate as early as May. In the third quarter of the year when the great slump occurred, most of the producers were uncertain in their policy, opining that each cut in prices marked the bottom, with chances for an upward reaction, and the comparatively small demand was met by the few who had all along been selling freely and steadily at the market. Chief among these was the Calumet & Hecla. That company does not report the amount received for its copper, but gossip credits it with an average of nearly 20c. per lb. for the year, which is not improbable. Most of the other companies were unable to market any large quantities of copper until the last quarter of the year, when the price was low, wherefore their low averages, and wherefore also the great range in their receipts from the 19.34c. per lb. of the Franklin down to the 16.24c. per lb. of the Michigan.

As we have explained above, the Adventure, Allouez, Centennial, and Quincy are not included in the above table. The Adventure received an average of 17.71c. per lb. for 1,244,874 lb.; the Allouez received 18.99c. per lb. for 2,934,116 lb.; the Centennial received 18.46c. per lb. for 2,373,572 lb.; the Quincy received 18.78c. per lb. for 19,796,058 lb. In each of these cases

the average is affected by the low price received for copper sold in January, 1908, and consequently if they had reported separately their sales in 1907 they would have made an even better comparison with the other companies.

In the following table we give the average receipts of the Lake companies in comparison with our quotational averages for the last three years.

Year.	Amount Sold.	Average Per Lb.	Quotational Average.
1905....	120,469,514	15.608	15.699
1906....	114,408,920	19.111	19.616
1907....	66,316,025	18.043	20.661

The above table shows that while the average of actual receipts may closely approach the quotational average on a rising market, it is apt to fall very far short on a falling market. Undoubtedly the closest approach occurs on a constantly fluctuating market, moving between comparatively small extremes. In 1905 there was a fluctuating market with an upward tendency, especially toward the end of the year. In 1906 the market was a steadily rising one, except for a few trifling setbacks. In 1907 the market remained rather regularly at a high figure for five months and then declined in a way previously unparalleled either in rapidity or extent. The producers who realized the monthly average were very fortunate.

Miners and Smelters

The article by Mr. Adkinson, elsewhere in this issue, will be read with great interest by an army of ore producers. A discussion of the payment which they receive for their ore pertains to a vital subject. Mr. Adkinson is able to communicate extremely valuable data, and moreover to present it in a logical and lucid manner. His paper is not only of great present interest, but also will be of value to the historian in outlining year by year the changes in terms for ore that occurred at an important period of mining history, viz., the years immediately following the organization of the smelting trust.

However, there is one point in Mr. Adkinson's paper to which it is necessary to call special attention, lest it convey an impression which he really does not intend to give. This refers to the unknown items which he credits to the smelter with an interrogation, his purpose being merely to imply ignorance. He bases his calculations upon the whole metal content of the ore, at the New York price, and on that basis shows what appears to be an extraordinarily large division of the value in favor of the smelter. Of course, as a matter of fact, the smelter does not actually realize any such proportion. In the first place the smelter does not secure 100 per cent. of the metals, a more or less quantity being lost in the processes of smelting and refining. In the case of gold the loss is insignificant, but in the cases of silver and lead it may amount to 3 and 6 per cent., respectively. Secondly, the price named for ore at Denver or Salt Lake City is based on crude metal, 2000 to 2500 miles distant from its market. The cost of carrying the crude metal from Pueblo, Colo., and Salt Lake City, Utah, to New York is about 0.32 and 0.55c. per lb., respectively. Finally the cost of refining, lighterage charges, selling, etc., at New York, amounts to about 0.4c. per lb. of crude lead. Consequently, when the smelter bases his settlement on the New York price for lead less 1c., 1.5c., or 2c. per lb., as the case may be, he is allowing for those expenses and is not gaining a clear advantage. Indeed, any advantage actually remaining on this account may be merely offsetting some disadvantage in another specification of the contract. The smelter does not base his calculation upon any single detail of the terms, but rather upon the net result, after footing up all the plus and minus items, which he calls the "margin."

Miners and the smelters necessarily look upon the question of the valuation of ore from radically different standpoints. The miner thinks naturally of his own particular ore and bases his calculations upon what it yields him. The smelter, on the other hand, thinks of the composite ore which he prepares out of the products of many mines so as to produce a mixture which can be smelted economically. Some of these ores he may be obliged to buy on terms which leave no margin for profit; the deficiency must be made up by increasing the rates on other kinds of ore.

Production and Absorption of Gold

Some interesting figures compiled by the *Commercial and Financial Chronicle*, of New York show to what extent the absorption of gold is regulated and changed by a demand for currency and cash reserves in a period of financial stress. In this statement, which covers the three months ended March 31, we have definite figures for the production of gold in the Transvaal, Australasia and India; the output in the United States and other countries is, of course, estimated. The figures are as follows:

	1907.	1908.
Gold production.....	$100,683,000	$104,367,000
Bank holdings U. S. and Europe, Jan. 1...	$3,351,300,000	$3,567,000,000
Holdings, April 1.....	3,400,000,000	3,656,500,000
Increase.....	$ 48,700,000	$ 89,500,000
Gold not going to banks	$ 51,983,000	$ 14,867,000

In other words, in the first quarter of this year 85.8 per cent. of the approximate gold production of the world was added to bank reserves and currency; while 14.2 per cent. was absorbed in the arts or served to increase private stocks. In 1907, the bank gains were only 48.4 per cent. of the gold production, 51.6 per cent. going elsewhere. If we go a year further back, to 1906, we find the proportion showing in bank reserves to have been only 23.1 per cent., 76.9 per cent. going elsewhere. And yet the first quarters of 1906 and 1907 were periods of extremely active trade, when money was in general demand.

The general conclusions to be drawn from this statement are that a period of great financial stringency may coincide with one of large gold production; the crisis being the result of other causes than the gold supply. Further, that such a period of stress, with consequent high interest rates, will draw out gold reserves which have been hidden, or at least have not been apparent or directly available. Finally, it is only a repetition of former experience that a time of financial trouble is followed by a period of decided monetary ease. This, however, is not the result of the gold supply, but rather of the general withdrawal of money from active and speculative use.

The Treasury Department's estimate of the gold in the United States Jan. 1, 1908, was $1,604,530,493, of which $249,343,971 was held in the Treasury, and $1,355,186,522 was in circulation — either as coin or in certificates representing deposits of coin in the Treasury; circulation, of course, including coin held by banks in their reserves. On April 1 this estimated amount of gold had increased to $1,642,565,614, of which the Treasury held $204,492,080, the balance of $1,438,073,534 being in circulation. The increase in the total stock in three months was $37,961,587, or more than the production.

Views, Suggestions and Experiences of Readers

Comments on Questions Arising in Technical Practice or Suggested by Articles in the Journal, and Inquiries for Information

CORRESPONDENCE AND DISCUSSION

Coal-dust Firing of Reverberatory Furnaces

Pulverized-coal firing is very well understood in the cement industry which has borne the entire burden of the experimental work necessary to bring it up to its present high state of efficiency. The article by C. F. Shelby in the JOURNAL of March 14 was the first intimation received that work had been done with it in reverberatory furnaces.

As an engineer devoting nearly all my time to the study of inefficient cement plants, or the initial operation of new ones, I have met with coal-dust-burning apparatus of nearly all types, with various kinds of coal, and many different conditions as to draft, air or steam pressure used, fineness of coal, temperatures desired, flue-dust chambers, waste-gas flues, and the use of waste gases for boilers, economizers, feed-water heaters, etc. It is needless to state that the design or manipulation of each element is sufficiently critical to influence the success of the whole.

S. S. Sörensen, in the JOURNAL of Feb. 10, 1906, names the following desirable features of coal-dust firing: "(1) Action is continuous, no stops for grating; (2) the heat generated is uniform and steady; (3) combustion is complete at all times; (4) combustion is rapid and concentrated, therefore productive of high temperatures; (5) the combustion takes place in the laboratory over the hearth where the heat is wanted."

CONSTANT TEMPERATURE

It is a well known principle of metallurgical work that the efficiency of a furnace varies directly with the continuity of the process, for the losses due to heat radiation are great. Hence the desirability of perfecting some method of firing that will give a steady supply of heat. It is a boast among cement-kiln burners that they can so regulate the conditions existing in their kilns that they can go through their shift of 12 hours and not change the supply of coal should the feed of raw material be constant. This suggests the uniformity possible with pulverized coal as fuel under correct conditions. The effect of constant temperature, as compared with the variable temperature obtained with grate firing, on the roof and sides of the furnace needs only to be mentioned to be appreciated.

Having the combustion take place over the hearth is another advantage that will appeal to any engineer. In a recent test with a jet burner I experienced no trouble in maintaining a smelting temperature the entire length of a 125-ft. kiln, and this, too, with only 12 oz. of air pressure.

FUEL CONSUMPTION

In a cement kiln it is necessary to bring the raw material up to a temperature of 1400 deg. C. Should the results there obtained be considered as any criterion of what to expect in a reverberatory furnace fired in the same way, the thermo-efficiency of the one being at least no greater than that of the other, the comparison would be in favor of the pulverized coal. The best test that I ever obtained showed a fuel consumption of 220 lb. of dry coal per ton of raw material burned. This was an average for three months and the figures used have been verified by the highest authority. Another average consumption of 250 lb. of coal per ton has been made and verified. A fair average of the entire industry would be less than 300 lb. of coal per ton of dry raw material.

Compare these results with those obtained in reverberatory practice. Mr. Sörensen's article on the Highland Boy plant shows that 1000 lb. of coal were used per ton of ore, as an average of two months. Mr. Shelby's article would indicate that about 520 lb. is used at the Anaconda works. Judging from Mr. Shelby's article he used rather more than 500 lb. of coal per ton of ore, and had his troubles with the same thrown in for good measure. It is also to be noted that in cement burning the raw material is fed into the kilns cold, whereas the furnaces referred to were supplied with hot material.

If the use of pulverized coal as fuel has done so much for the cement industry, is it unreasonable to expect that its use should improve present reverberatory furnace practice? It is not to be expected that the pioneers in its application to smelter practice will meet with no difficulties in its special use in that work. On the other hand, if it be true that its use will promote longer life to the furnace, make at least a saving of 50 per cent. in fuel, make possible the use of much poorer grade of fuel, and produce a better product, then it is evident that its use offers a considerable advantage.

A FEW TESTS NOT CONCLUSIVE

Summing up the results of the few pulverized-coal-burning tests in reverberatory furnaces that have come to hand, it is evident that they were made with the least possible change necessary to apply the apparatus to the furnace, and the other difficulties were given attention only as they became apparent. These simple tests all seem to show that the results obtained regularly in cement practice might be approached with the reverberatory furnace should it be well designed and carefully operated.

No positive commercial success can ever be hoped for until some person in a position to take advantage of all past experiments with coal-dust firing in all industries will take the time to study some particular set of conditions as to available fuel, material to be treated, effect of the gases from the material on the fuel residue, and then to proceed, step by step, with his design, giving each element the benefit of knowledge gained by most careful search of all the previous work done along similar lines, drawing conclusions only after each cause and effect has been weighed and proportioned. In this way it should be possible to construct a reverberatory furnace that will smelt ordinary pyrite ore using a maximum of but 300 lb. of coal per ton of ore, and still get large returns from the waste-gas heat units. When hot material is fed into the furnace even this low figure should be reduced.

In present reverberatory practice, according to available data, it seems that during 20 to 50 per cent. of the time the furnaces are not doing efficient work on account of grating or charging. Suppose that we have a reverberatory furnace fitted with the best pulverized-coal-burning apparatus in the market, and that every detail of design and construction of the combination has been worked out in a manner to represent the very best engineering skill that can be secured. Put this outfit in charge of the ordinary smelter-furnace man, prejudiced as he would be, with no previous experience with pulverized coal to guide him, and I am afraid that the "patent" furnace would not prove very successful. When such a combination becomes a reality, and some wide-awake smelter manager will make it possible, the apparatus should be put in the hands of a vigilant, resourceful engineer, and he should never leave the works after it is fired until its performance is satisfactory. A new cement plant is rarely put in successful operation until someone with greater experience and ability than the average operator, spends a week or more at the works, getting what sleep he may in some improvised berth, but stand-

ing night and day ready to make such corrections in mode of operating as is necessary to bring about the highest efficiency and at the same time doing his utmost to teach each shift the best possible manipulation of the material and apparatus.

THE WASTE-HEAT PROBLEM

No doubt the addition of economizers or boilers to utilize the available heat units in the waste gases does complicate the problem to a marked degree; but the fact that it is now being done in various places in cement-mill practice seems to indicate that its application to a reverberatory furnace is not impossible. The designer, and operator as well, should take advantage of the valuable lessons taught by past experience. The addition of boilers need not impair the efficiency of the furnace if the operator bears in mind Mr. Shelby's suggestion that a smelter is not operated to keep blowing engines in operation, but to produce metal. I have in mind a case in which a boiler plant was fired with the waste gases from cement kilns. The kilns were under the charge of the mill foreman and the boilers under the supervision of the steam engineer. The mill foreman wished to produce "clinkers," and in my judgment he was right, but the steam engineer wanted to control his fires, for the supply of heat was sometimes too great and sometimes too small. Although the plant was successful in utilizing waste heat from the gases, it became necessary to separate the units because the friction between the departments caused greater losses than the saving in fuel amounted to.

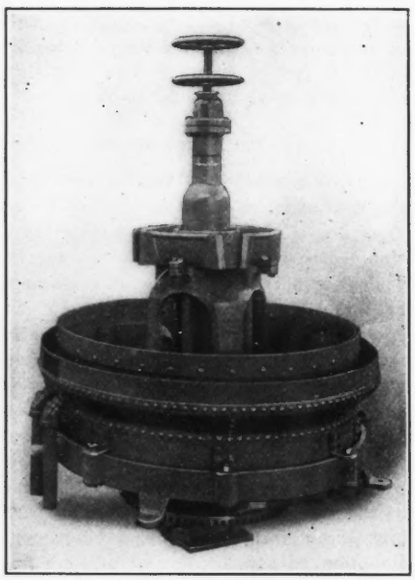
In regard to the importance of proper operating, allow me to cite a recent incident. One of the best, if not the best, designed cement plants in existence was put in operation, and for a period of time failed to produce cement on a commercial basis. Without making a single correction in design, this plant in three days was brought up to so high a standard of efficiency that it broke all previous records in both capacity per kiln and fuel consumption by 35 per cent. So much for careful operation. A plant is designed but once, but its operation covers *all of the time.*

E. A. RICHMOND.

Grand Rapids, Mich., March 21, 1908.

Pans for Regrinding Homestake Tailings

In the JOURNAL of April 11 there was a reference to the regrinding of stamp-mill tailings by the Homestake Mining Company. It may be of interest to state that the grinding pans are of a type brought out to meet the special requirements of the Homestake problem and are not of the "regulation Wheeler type." The accompanying illustration shows one of these pans as it appeared in the shops of the Colorado Iron Works Company ready for shipment. They are continuous grinding pans with the feed led down through pipes from the annular feed box to a point about the inner edges of the mullers; the product discharges over the top of the curb into a launder surrounding the pan. The narrow annular space at the top of the



PAN FOR REGRINDING HOMESTAKE TAILINGS

curb is to receive a strip of wood or lead of such width as may be desired; it offers a means of regulating the hight of overflow and the consequent fineness of the product, as well as allowing the overflow to be maintained at a level independent of the bottom of the pan. The dovetailed sockets on the outside of the feed box are for compensating weights which are not shown. H. B. LOWDEN.

Denver, Colo., April 17, 1908.

The Proposed Bureau of Mines

The editorial in the JOURNAL of April 25, and Dr. Raymond's letter in the same issue, relative to the proposed bureau of mines, are both of such importance and treat the matter in so logical a manner that I wish to indorse them, and to say that if any marked benefit results from the proposal that the Government establish a department of mining, successful accomplishment will have greater assurance through an engineering commission as the JOURNAL has suggested, because the essential qualification is not an administrative one, but rather concerns matters of research and investigation. The most important necessity, however, is for a competent and politically independent body which will lay before the people at large, facts already known to a limited number.

Chicago, May 4, 1908. A. BEMENT.

Cyaniding at Guanajuato

In my paper on cyaniding at Guanajuato, in the JOURNAL of April 4, I neglected to state that the cost of power is $80, gold, per horse-power per annum. With this exception all the working costs given in the paper are in Mexican currency. I may be allowed to take this opportunity to correct a clerical error. It was stated that the dimensions of the spitzkasten are 22x22x22 ft., instead of 22x22x22 in.

It was to challenge the attention of metallurgists that I expressed in my paper the doubt that the method of raw pan amalgamation would ever again be adopted in any new installation for the treatment of silver ores. It is a great pity that mine managers and engineers do not record their experiences, even those of a trivial character, in the technical press. Such records would add spice and life to technical literature, but lack of time necessary to finish carefully a literary paper seems to deter most of these men from recording their experiences.

BERNARD MACDONALD.

Guanajuato, Mexico, April 14, 1908.

[Mr. MacDonald is entirely correct in his statement that it is a great pity that mine managers and engineers do not record their experiences in the technical press. It is the greatest function of the technical press to record such experiences. Is Mr. MacDonald correct in his suggestion that lack of time to prepare contributions for publication in a satisfactory way, i.e., the time required to give a literary polish, is a reason why many practical men refrain from writing about their experiences? If that be really so, we make haste to say that it is not a good reason. In the first place, the men who have done things, and give a simple descriptive account of what they have done, are usually the ones who write best. Thus Julius Cæsar, General Grant, and, latest, Lord Cromer, rank highly for the excellence of their literary style, but when they wrote probably were unconscious that they possessed a style. Flowery verbiage is never desirable anyway. In technical writing it is the ideas that count, and not the mere assembling of words. True, the words should be properly used, so that the meaning may be precisely conveyed, which is their chief function. It is one of the duties of the editor to see that his contributors present their ideas in a good way. The editor is quite as anxious to insure that as is the contributor, and every contributor may rely upon the editor to take care of him if necessary.—EDITOR.]

The pyrites mined at Pilley's island, Newfoundland (*The Iron and Coal Trades Review*, April 3, 1908), yields 54 per cent. sulphur.

Yukon Gold and Some Other Mines

SPECIAL CORRESPONDENCE

A report made by H. H. Rowatt has just been published at Ottawa,[1] which was prepared in accordance with the instructions of Hon. Frank Oliver, Canadian Minister of the Interior, who commissioned Mr. Rowatt to investigate conditions in the Yukon last summer. It is of special interest at the present time, as it deals mainly with the operations of the Yukon Gold Company.

THE YUKON GOLD COMPANY'S PROPERTY

At the time of Mr. Rowatt's visit in August, that company had acquired about 950 claims on Bonanza, Eldorado, Hunker and Bear creeks and their tributaries. From the mouth of Bonanza creek to No. 30 above discovery, a distance of about 15 miles, the company had acquired all the creek claims excepting seven, and on Eldorado creek it controlled all claims up to and including No. 23, a distance of about 2½ miles. On Hunker creek and its tributaries it had 160 claims; on Bear creek 22, and on the Klondike benches 37 claims. The company had also possessed itself of nearly all the hill and bench claims along these streams. This gives it a connected mine of probably greater length than any of its kind.

The company was operating on Bonanza creek two Risdon dredges of the largest pattern, with a capacity of between 2000 and 3000 cu.yd. per day according to the nature of the ground. Four additional dredges were then under construction, and the company expected to have in operation this season (1908) seven dredges, four on Bonanza and three on Hunker creek, representing an expenditure of over $1,000,000 and under favorable conditions capable of handling some 20,000 cu.yd. of gravel per day. It has been shown that frozen ground cannot be profitably operated by a dredge as in that condition it is passed through the screens and over the plates without giving up the gold. But it has been found that if the surface of moss and decayed vegetation is scraped off, the gravel will thaw down to bedrock in about one season, and a force was employed in stripping and sluicing a large area on lower Bonanza, to prepare the ground for this season's work. Thawing operations were carried on in advance of the dredges by steam points.

POWER FOR WORKING

The power used in operating the dredges is electricity generated by a power plant at the mouth of Little Twelve Mile river, 35 miles from the scene of operations. The two generators in use develop about 2000 h.p., which is conveyed by a transmission line comprising three copper wires in a direct line to the head of Trail gulch, a tributary of Bonanza creek about 3 miles from its mouth, and reaches the point of operation with about 97½ per cent. efficiency. As the maximum power required for each dredge is about 300 h.p., the power plant already installed is capable of operating the dredges to be put in commission, and also of supplying power for elevators for sluicing ground to be worked by hydraulic process on the lower levels.

WATER SUPPLY

The Yukon company has acquired the right to impound the unentered and unappropriated waters of Bonanza creek by a dam at claim No. 56 above discovery, and has erected a dam about 400 ft. in length at the bottom of the stream and about 500 on top, with a base 230 ft. wide, tapering to a width of 40 ft. at top. It is 70 ft. high, stone-faced, and forms a reservoir nearly 1½ miles in length, at a cost of about $200,000. The company has sunk large sump-holes about 20 ft. into bedrock at intervals along Bonanza creek, and will use the water from the reservoir to hydraulic the creek bed into these holes and elevate the wash-dirt by electric elevators.

The company has acquired the right to divert 5000 in. of water from Tombstone creek, a tributary of Twelve Mile river, on its left limit about 20 miles from its mouth, and a like quantity from the main stream about 10 miles higher up.

This water will be carried through a ditch, pipe and flume for about 70 miles to the head of Trail gulch at a sufficient elevation to command the workable gravels in the Bonanza basin. Of the 70 miles that this water is carried, only about 40 miles is by ditch, the remainder being by flume and pipe. The Little Twelve Mile, Lepine and Klondike depressions are most difficult and are crossed by inverted syphons, 49 in. in diameter, made of steel from ⅝ in. to ¾ in. thick. The total length of steel pipe is 5½ miles, and the total weight of steel used 3500 tons. At the greatest depression on the Klondike river the water is delivered at the top of Thomas Dome, 110 ft. above the bed of the stream, subjecting the pipe to a lateral pressure of about 520 lb. per square inch. The total length of the syphon is 13,600 ft. and it weighs some 17,000 tons, being carried across the Klondike river on a steel bridge with concrete piers. Over lesser depressions the water is carried through California redwood pipes of the same dimensions hooped with ½-in. round iron. Over about 20 miles of the entire distance the water is carried through a flume 7x4 ft., constructed of native timber and supported for the greater part of the way on trestles. The ditch is about 15 ft. wide at the bottom, with sloping sides, and capable of carrying more than 10,000 in. of water. At the time the visit was made about 1400 men and 280 horses were employed on the work, the payroll for August last amounting to $170,000. The ditch will probably be approaching completion in the autumn of 1908, provided the material for the syphons is duly delivered. The total cost of the water system is estimated at over $2,500,000.

FUTURE OPERATIONS

The report points out that by means of the large quantity of water made available at a sufficient hight to operate the working gravels of the district, large areas can be operated which heretofore have been scarcely touched, owing to the difficulty of getting water on these high bench lands at a sufficiently low price to make their operations profitable. As the company had acquired many placer claims in the Klondike water-shed, where the operations last season were limited, Mr. Rowatt anticipated an immediate decrease in the Yukon gold output followed by a very material increase when the water system was in full operation, bringing up the production for a few years at least, almost to the figure of past years.

OTHER COMPANIES

The report also gives details of the operations of other dredging companies, and of hydraulic and placer mining, both of which industries were considerably handicapped by scarcity of water. Particulars are also given as to the progress ot copper mining at Whitehorse; there is promise of that locality becoming an important mining camp. Development was being actively carried on and it was claimed that the ore from the working mines averaged 6 per cent. copper. The cost of mining, shipping and treatment was estimated at from $12 to $13 per ton.

The principal lead-producing districts of Montana have been Glendale (Beaverhead county), Wickes (Jefferson county), Barker and Castle (Meagher county). Smelting has been conducted at several of these points, but the center of that industry is Helena, where is located a large plant of the American Smelting and Refining Company.

Colorado was for many years the leading producer of lead in the United States. At present, although its output of lead ore has decreased, it still contains several important lead-smelting centers, and the quantity of ore reduced within its borders is much larger than the production of its mines. There is one smelting works in regular operation at Denver, two at Pueblo, one at Leadville and one at Durango. A part of the bullion produced at those points is desilverized in Colorado, but the most part is shipped to Eastern refineries.

[1]Report with Respect to the Yukon Territory, 1907. By H. H. Rowatt. Pp. 20; illustrated, 10x6½ in. Ottawa, 1908, Government Printing Bureau.

Utah Consolidated Mining Company

The report of this company for the year ended December 31, 1907, gives the following statement of production and net profits:

PRODUCTION AND EXPENSES

The production of the mine in 1907 was 271,332 tons of copper ore and 1734 tons of lead ore. The smeltery treated 272,989 tons of copper ore from the company's mine and 6653 tons of custom ore, an average of about 748 tons per day. At the end of the year the amount of copper ore developed was 1,202,930 tons, against 1,100,000 tons at the end of the previous year. Several new orebodies were discovered during 1907, and the outlook for the mine is regarded as promising.

In January, 1908, the company made a contract with the Garfield Smelting Company for the treatment of 800 tons of ore per day, this contract being for one year with option to renew for another year. Its terms are said to be advantageous to the mining company. The latter has purchased 1600 acres of land (in and below the Pine cañon, Tooele county, about 3.7 miles north of the mine) as a site for the new smelting works. Seven miles of railway will be required to connect this site with the San Pedro railroad, and an additional seven miles to connect with the Western Pacific near Garfield. The new smelting works will be of capacity for 1500 tons of ore per day.

STATISTICS OF UTAH CONSOLIDATED COPPER COMPANY.

	1904.	1905.	1906.	1907.
Ore treated, tons	233,700	286,200	296,989	279,642
Copper, lb.	13,553,483	17,264,474	18,533,974	13,987,551
per ton of ore	57.9	60.3	62.4	50.0
Silver, oz.	268,880	374,685	457,812	390,296
per ton of ore	1.1	1.3	1.6	1.4
Gold, oz.	23,374	28,290	42,601	34,554
Net profit	$1,179,412	$2,835,008	$1,887,385	$1,164,348
Mining cost	.....	.....	$473,760	$582,866
Exploration and development	.....	.....	84,864	107,155
Smelting cost	.....	.....	$747,717	$867,087
Custom ore purchases	.....	.....	274,032	131,796
Refining charges, freight, marketing, etc.	.....	.....	267,921	227,152
Miscellaneous	.....	.....	70,773	70,754
Total cost	.....	.....	$1,919,067	$1,986,810

American Smelting and Refining Company

S. R. Guggenheim, of the American Smelting and Refining Company, prior to his departure for Europe, May 5, made the following statements to the New York *Herald:*

"It is with reluctance that I discuss the statement that the control of the American Smelting and Refining Company has passed to other interests, because I believe that Wall Street sets in circulation rumors of this kind merely for the purpose of drawing out denials. I wish to say, however, that if John D. Rockefeller, Jr., and his associates have acquired a substantial block of stock in the Smelting and Refining company no request for a representation on the board of directors or intimation to that effect has been made. I can say for myself and my brothers that representation would be willingly given young Mr. Rockefeller if he demands it.

"There is no intention on the part of the American Smelting and Refining Company to antagonize the United Metals Selling Company or the Amalgamated Copper interests by withdrawing the marketing of its copper from the selling agency of the Amalgamated interests. Our chief copper-producing company, the Utah, has renewed its contract for one year with the United Metals Selling Company, a fact which ought to be sufficient answer to the charge of unfriendly relations with the Amalgamated interests.

"Concerning the report that the Guggenheims have sold the bulk of their Smelting and Refining common stock, and that the control of the company is either distributed 'in the street' or in the John D. Rockefeller interests, Wall Street has simply created a man of straw, to be used alternately in bearing or bulling the market for Smelting shares. The Street forgets that the control of the Guggenheim Exploration Company, which is lodged absolutely with the Guggenheim brothers, is vitally essential to the American Smelting and Refining Company. The control of a large number of important copper and other mines is owned by that company, and they are great feeders to the Smelting company."

This statement is regarded as a tacit admission that there is some truth in the recent gossip respecting a change of ownership in large blocks of the stock of the Smelting company.

Coppermines and Yukon

William B. Thompson and James Phillips, Jr., have resigned as president and vice-president respectively of the Coppermines Company, which aims to consolidate the Utah Copper Company, Nevada Consolidated and Cumberland-Ely. They have been succeeded by E. G. Johns as president and H. F. J. Knobloch as vice-president. Mr. Johns is a curb broker, and was formerly in Hayden, Stone & Company's New York office. Mr. Knobloch is secretary to Mr. Thompson.

It is well known that it was the plan of Thomas W. Lawson to follow the sale of the Yukon shares with some transaction in the proposed copper consolidation. Since the frost that nipped the Yukon bud, but little has been heard of this. Just what happened to the Yukon flotation is a deep secret. Lawson hinted of dark doings and threatened a startling revelation. It has been gossiped for several weeks that when the stock was going like hot cakes on the memorable Saturday, there appeared on the market large offerings of stock other than the treasury stock, which alone was supposed to be for sale. Some owners could not resist the temptation. This common suspicion lends interest to a recent interview in a financial newspaper, apropos of the contemplated copper consolidation, attributed to a "leading interest" in the companies concerned, who says:

"There is no doubt in my mind as to the ultimate consolidation of these properties, but I do not believe that the consolidation can ever be brought about through the Lawson connection. The latter is apparently an unholy alliance brought about by Samuel Untermyer and the Guggenheims, but already the latter are beginning to see the effect of the Lawsonian connection, and it is not a very pleasant situation for them. This does not get away from the fact, however, that Lawson has an option on the coppers in the treasury of the Guggenheim Exploration Company, which option has about five months yet to run.

"The whole matter may be held up until these Lawson options expire, but Lawson is not a man to sit idly by and see valuable options go by the board. The whole trouble is that Lawson did not get the support in Yukon flotation he anticipated. If he had, the entire 700,000 Yukon shares would have been sold, and he would have been in a position to have taken hold of the bigger copper job, and in the meantime he would have cleaned up over $500,000. The trouble was that previous to the public offering, about 200,000 shares of Yukon stock were distributed privately at $5 and $5.50 per share, and this stock Lawson had to take back in the open market. Yet in the face of having to take back this stock about 400,000 shares of Yukon stock were distributed among about 3000 stockholders."

At the present time the major part of the lead produced in the United States is derived from the argentiferous ores of the States and Territories west of the Rocky Mountains, where the silver lead industry began to attain importance with the discovery of the great ore deposits at Eureka, Nevada, and the completion of the Pacific railway, both in 1869, although lead ore had previously been mined and smelted on a small scale in Arizona, Colorado and Montana. At the same time the rich mines of Cerro Gordo, Inyo county, Cal., began to be largely productive.

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

Alfred Tellam is superintendent of the Ortega Mining Company, at Cananea, Sonora.

James Chynoweth has resigned as president of the Superior & Boston Mining Company, owing to ill health.

J. W. Bryant and W. M. Brewer are examining mining properties in southeast Alaska for the Tyee Copper Company.

Bernard MacDonald, of Guanajuato, Mexico, is in New York for a short visit. His headquarters are at 35 Wall street.

Howard G. Wright has been appointed superintendent of the Phœnix stamp mill, owned by the Keweenaw Copper Company in Keweenaw county, Michigan.

D. R. Blower, of Johnstown, Penn., has been appointed mine inspector for the sixth bituminous district of Pennsylvania, to succeed Josiah T. Evans, resigned.

Ferdinand Sustersic has resigned as general manager of the Amparo Mining Company, at Etzatlan, Jalisco, Mexico, in order to attend to his personal business.

H. R. Conklin has resigned as superintendent of the Missouri Lead and Zinc Company, at Joplin, Mo., and will go to Mexico, to take charge of mining interests there.

H. Hunter has gone to the East, to take charge of the mining and metallurgical interests of E. H. Hunter & Co., of London, in the Far East. His address will be at Kobe, Japan.

Richard Eames, Jr., of Salisbury, N. C., has been appointed manager of the Iola gold mine, in Montgomery county, N. C. Capt. Eames has had extensive experience in gold mining in the South.

Harley E. Hooper, recently mining engineer for D. A. Sutherland, of London, has been appointed metallurgical chemist to the Maoriland Copper Company, of Richmond, Nelson, New Zealand.

Herbert C. Burchell, of Sydney, N. S., managing director of the North Sydney Cement Company, has been offered the position of director of works for Jamaica by the British colonial office.

F. N. Flynn, for the past year manager of La Rose, Lawson, University, and other mines belonging to the Timmons-McMartin corporation, at Cobalt, Ont., has resigned and will shortly return to the United States.

Barney F. Shearer, formerly superintendent of the Mohawk and Wolverine stamp mills, has been appointed superintendent of the Michigan stamp mill at Keweenaw Bay, Mich., and will have charge of erecting the mill.

W. P. Smith, superintendent of the Quincy smelting works at Hancock, Mich., has tendered his resignation to take effect Aug. 1. Alex Laist, of Salt Lake City, Utah, is at the plant and will succeed Mr. Smith as superintendent.

S. E. Bretherton, who recently opened an office in San Francisco as consulting engineer and metallurgist, still retains his position as general manager of the Great Western Gold Company, with mines and smelter at Ingot, California.

Frank H. Wigton, of the Morrisdale Coal Company, has resigned as president of the Central Pennsylvania Operators' Association. Hon. James Kerr, president of the Pennsylvania, Beech Creek & Eastern Coal Company, has been elected to fill the vacancy.

Thomas Haight Leggett and Fred Hellmann have entered into a partnership as from May 1, 1908, for the purpose of carrying on a general business as consulting mine engineers. Their offices are at 530 Mills building, Broad street, New York, and 832 Salisbury House, London, E. C., England.

T. R. Drummond, formerly general manager of the Dominion Copper Company, of Greenwood, B. C., and afterward manager of the Nipissing Mining Company, Cobalt, Ont., has been appointed superintendent for the Newhouse Mines and Smelters, at Cactus, Utah, succeeding Alexander D. Moffatt.

Jas. McEvoy, of Fernie, B. C., chief engineer and land commissioner of the Crow's Nest Pass Coal Company, has resigned to accept an appointment with the German Development Syndicate, which last year acquired coal lands in northern Alberta. Mr. McEvoy was for years a member of the Geological Survey of Canada.

On the death of the late State geologist of Georgia, W. S. Yeates, Prof. S. W. McCallie, for a number of years senior assistant geologist, was appointed State geologist. S. P. Jones, some years back assistant State geologist, who has recently been doing special work in petrography at the University of Wisconsin and at Sheffield Scientific School, at Yale University, has been appointed assistant State geologist. The staff of the survey now consists of S. W. McCallie, State geologist; Otto Veatch and S. P. Jones, assistant State geologists; Edgar Everhart, chemist.

Obituary

William Dana Ewart, inventor of the "Link Belt" and founder of the Link Belt Engineering Company and the Ewart Manufacturing Company, since absorbed by the Link Belt Company, died in Rome, Italy, May 3, aged 57 years.

Alvan Reese, who died April 24, aged 79 years, had been connected with the iron and steel trades for over 60 years, and was widely known as an inventor. Born in Wales and brought up in Pittsburg, he had been manager and engineer for many enterprises, and had superintended some of the earliest shipments of Lake Superior iron ore to Pittsburg furnaces. Among his inventions were mills for re-rolling old rails, heavy plate mill, and the well-known "universal mill" for plates.

Alfred Habets, for 30 years the editor of the *Revue Universalle des Mines* of Liège, Belgium, is dead. Born at Liège in 1839, M. Habets graduated with honors in 1863, was appointed tutor of metallurgy at the Ecole des Mines in 1865 and of mining engineering a year later. In 1879 he became professor of mining engineering, a post which he filled to his death. He was closely identified with the Association des Ingenieurs and was a juror at nearly all the great exhibitions. He was secretary for many years of the union of collieries, mines and metallurgical works of the Province of Liège and was an active member and president of the Geological Society of Belgium.

Societies and Technical Schools

Americal Chemical Society—At the meeting of the New York section on May 8, Professor Charles E. Monroe, of the George Washington University, Washington, read a paper on explosions in mines.

Association of American Steel Manufacturers—This association held its annual meeting May 2, at Pittsburg, with representatives present from the leading steel companies comprising the membership. Among other technical matters, it was decided to continue the effort that was begun some years ago to discourage the use of numbered gages in measuring the thickness of sheets, plates, bars, etc., in favor of dimensions expressed in thousandths of an inch. The following officers were elected: President, W. A. Bostwick, metallurgical engineer, Carnegie Steel Company; vice-president, A. A. Stevenson, superintendent Standard Steel Works Company; secretary-treasurer, Jesse J. Shuman, inspecting engineer, Jones & Laughlin Steel Company.

University of Wisconsin—E. C. Holden, formerly of Hill, Holden & Irvine, New York, has been elected Professor of Mining in this university at Madison. Mr. Holden is a graduate of Columbia, with a wide range of experience as engineer and operator. The University of Wisconsin has been giving the larger part of a mining course, and many of its graduates have gone into mining and economic geology. With the addition of courses to be offered by Mr. Holden, the university will now give regular four- and five-year courses in mining, leading to the degree of mining engineer. The mining course being the result of expansion of university work in engineering and geology, it is probable that the primary emphasis will be, as in the past, upon these subjects.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Goldfield, Salt Lake City, San Francisco and Indianapolis

REVIEWS OF IMPORTANT EVENTS

San Francisco

May 6—The Rush Creek Mining Company, of Quincy, the largest hydraulic mine in Plumas county, has decided not to operate by hydraulic process this season, but will install electric pumps, hoists, etc., and work the mine by the drifting method. This is an indirect result of the recent State Supreme Court decision declaring the permit and license issued by the California Débris Commission not effective in preventing injunction suits, as the company would now be at the mercy of anyone who might bring suit. H. Kling has resigned as superintendent of the Rush Creek Company and John Egbert has succeeded him and is now driving drifts.

Meantime the Anti-Débris Association has filed suits in Sutter county against several persons engaged in hydraulic mining; and one against Wm. Nichols, Jr., of the Southern Cross hydraulic mine, for alleged violation of a court injunction intended to prevent him from working the mine.

The quantity of snow remaining in the Sierras is small as compared with the same period last year. For example, on April 1 at Summit, there was left 62 in. of snow as compared with 262 in. in 1907. At Tamarack the total snowfall to April 1 was 328 in., or 403 in. less than for the corresponding time of 1907. The water supply will naturally be light this summer for mining purposes.

It is reported that the Yellow Aster mine at Randsburg, Kern county, the largest gold producer in the southern part of the State has been placed under bond to Albert Ancker of Tehachapi, who intends organizing a holding concern, and extending the scope of operations. The stock of this company is held mainly in Los Angeles. For several years past efforts have been made by different people to obtain a bond on this mine. There are shafts of 600 ft. depth, and about 15 miles of tunnels, drifts and upraises. The company owns two mills, one of 100 stamps, and the other of 30 stamps. The property consists altogether of over 40 patented mining claims, but only a few of these have been worked. The Yellow Aster has been worked about 13 years and still continues a very large producer. The present officers are John Singleton, president, C. A. Burcham, vice-president and R. L. Burcham, secretary.

A syndicate of Humboldt and Trinity county men have located, as individuals, some thousands of acres of dredging land along the Klamath and Trinity rivers. Those who made locations are Thomas H. Blair, Fred W. Blair, J. M. Dukes, F. P. Muelhner, H. A. Platt, J. M. Quay, J. M. Downer, J. A. Brent and B. W. Jackson. On the Klamath the claims are located in spots between Terwah Flat, in Del Norte county, which is three miles from the mouth of the river, up stream through Humboldt county into Siskiyou, two miles above Happy Camp. On Trinity river the locations extend from the mouth of New river in Trinity county to the Hoopa Indian reservation in Del Norte county. Eighty-two claims have already been filed.

The new magnesite mine on Tule river, in Tulare county, is being opened up and calcining furnaces built. The calcined material will be hauled from the mine to the railroad by traction engines, and these have been purchased and delivered.

The Valley Construction Company is about to reduce the cobble piles made by the dredgers at Oroville, into crushed rock for railroad ballast and macadam. Steam shovels, locomotives and a large rock crusher have been provided. The capacity of the plant is 100 tons of crushed rock an hour and there are so many orders that another plant will be constructed by the same company.

The Northern California Water and Power Company, which intends to establish extensive reservoirs in the vicinity of North San Juan, Nevada county, is meeting with better success in bonding the necessary property than it did at first, when exorbitant prices were asked. These have now come down to something like normal, as the people are beginning to realize that unless the project goes through, the ditch supplying small mines, farms, etc., will be discontinued altogether.

The Niagara mine in Nevada county has been closed down for lack of funds, after a checkered career. It is the property which Letson Balliet advertised so extensively a few years ago and in which considerable money was spent. Balliet received a States prison sentence for the manner in which he conducted operations in selling stock in mines. The stockholders of this property reorganized the company after Balliet's failure, and considerable development work was done. Evidently pay ore has not been met in quantity sufficient for profit, or further funds would have been supplied.

Ream and Long, the two prospectors who made the rich find at Brown's Valley, Yuba county, and named the mine the Solano Wonder got on patented land instead of the unoccupied 12-acre strip they supposed they were on. J. C. Campbell, of Grass Valley, the owner of the land got out an injunction and put a stop to their work. He has permitted them however, in view of their discovery, to take away the ore they had mined and hoisted, which is valued at some $20,000. The vein shows signs of permanency and will now be worked by Mr. Campbell, who owns the Bessie mine near by and has arranged to put up a 20-stamp mill.

The Standard mine at Bodie, Mono county, a very productive property, has been closed down for a time owing to reduction of wages. The camp has always paid the highest wages in the State—$4 per day. Owing to decrease in grade of the ore the company asked the men to accept a reduction of wages, but this request being refused, work at the mine has ceased for the present. Contemplated improvements have necessarily been postponed.

The Mammoth Channel Gold Mining Company, at Magalia, Butte county, is about to start a 6-in bore to tap the gravel in the channel below the lava cap. On the completion of the bore-hole work on the three-compartment shaft will be resumed. The tunnel to tap the shaft is expected to be finished by June, over 1000 ft. having already been cut. The channel being opened is supposed to be the outlet of the famous Pershbacker channel.

Goldfield, Nev.

May 5—The litigation between the Florence Goldfield Mining Company, the parent company, and the Little Florence Mining and Leasing Company, has been an important feature of the court calendar this week. The point of contention is a technicality depending on the meaning of the word level as used in the lease. The lease provides that no levels shall be run less than 50 ft. apart. From the 300-ft. level a winze was sunk, and from the bottom of the winze laterals were run on the vein and a large amount of high-grade ore was extracted. Whether this lateral is a drift or a level within the meaning of the lease is the point at issue. The Little Florence has filed many affidavits, setting forth that the lessees have not only not worked the mine in an unminerlike fashion, but that it is in much better shape than the average mine in Goldfield. J. H. Mackenzie, general manager of the Gold-

field Consolidated; A. J. Canavan, superintendent of the Mohawk; F. A. Lucy, U. S. deputy mineral surveyor; T. A. Rickard, and several others, are among those who have filed affidavits on behalf of the Little Florence. The case has been taken under advisement by the court.

The most important event of the week was the finding of rich ore on the 600-ft. level of the Mohawk. The importance of this is two-fold. It is the deepest working in the camp and thus justifies the prophesies made by many mining men that the ore would continue with depth. The shoot is a continuation of the famous Hayes Monnette shoot, from which one carload was shipped that brought $584,000. This ore was encountered in a crosscut driven about 380 ft. east from the shaft. The hanging wall side of the Goldfield veins is always much the richer, and big values are expected when the hanging is reached.

What was considered a very important merger was put through on May 1. It was the consolidation of four properties, the St. Ives, Velvet, Gold Horn and Pollack, into the Goldfield Merger Mines Company, with a capitalization of $5,000,000. The total acreage is 117, and it lies east of and adjoins the ground of the Consolidated. The new company expects to start immediately, sinking a three-compartment shaft 1000 ft. deep. Intermediate levels will be driven. The location of the properties is excellent and much is expected of them, although the production has not been great, perhaps about $100,000 from the St. Ives, and about $25,000 from the Velvet. Tom Lockhart, of the Florence, is one of the incorporators.

Salt Lake City

May 8—Special shareholders' meetings of the Swansea and South Swansea mining companies are to be held June 1, to vote on the proposition of consolidation. It is proposed to merge them into what is to be known as the Swansea Consolidated Mining Company, with 1,000,000 shares, of the par value of $1. Jesse Knight, of Provo, Utah, is the moving spirit in the enterprise.

The citizens of Park City will celebrate the reopening of the Ontario drain adit in a fitting manner during the week. The restoration of this avenue is an important event in the camp's history, and marks a new epoch in the progress of the noted district of Summit county.

The zinc plant erected at Park City by the Grasselli Chemical Company, for the treatment of the zinc ores of the Daly-Judge mine is said to be giving very satisfactory results. The Sutton, Steele & Steele process of dry concentration is being used, being the first equipment of the kind installed in the State of Utah. The mill has a capacity of 100 tons a day, but this will be increased.

Announcement has been made to the effect that the smeltery situated near Ogden has been optioned to a syndicate which proposes to operate it again. The plant was in commission last year for several months, but did not prove to be a profitable investment. It was built by the Utah Smelting Company, which entered into competition with the larger plants of the Salt Lake valley in the purchase of ores. This was during the high metal market times and when the financial crash came last autumn the company had a lot of ores on hand which could not be disposed of without a loss of at least a quarter of a million dollars. Finding it difficult to further finance the enterprise, the directors of the company ordered the smeltery closed. The new manager of the enterprise is J. B. Jensen, until recently connected with the ore-purchasing department of the United States Smelting, Refining and Mining Company, which leads to the supposition that possibly a close relationship will exist with the United States company as the latter will not be prepared to handle any copper ores in this State for some time to come, but will begin to receive lead ores about a month hence.

At the annual shareholders' meeting of the Nevada Douglas Copper Company, held here, a board of directors was chosen consisting of J. D. Wood, Windsor V. Rice, Frank J. Hagenbarth, Henry P. Henderson, J. H. Mays, J. J. Corum, Walter C. Orem, of Salt Lake; E. R. Hastings and A. J. Orem, of Boston. Manager Orem's report shows that the company between July, 1907, and Jan. 1, 1908, produced 1065 tons of ore averaging 15.3 per cent. copper and from which was produced 319,748 lb. of metal. The stockholders recently authorized a bond issue of $600,000, the proceeds from which are to be applied toward the further equipment of the mine and paying off the balance due on the purchase of the Ludwig mine. The management is taking steps toward the erection of a smeltery and other facilities to treat the ores produced on the ground. The Nevada Douglas mine is at Yerington, Nev., but is controlled by Salt Lake mining men.

There is every indication that the showing to be made by Utah mines in the way of dividends this year will not begin to compare with the record made last year, when distributions aggregated close to $7.000,000. The shutting down of the copper smelters of the Salt Lake valley as a result of litigation with the farmers, also the lead plant of the United States Smelting, Refining and Mining Company, together with the low prices paid for ores since last autumn, has greatly cut into the earnings of those mines which have in late years appeared in the dividend list. So far this year, the Utah Consolidated has paid $150,000; Utah mine, $12,000; Bullion Beck, $70,000; Colorado, $50.000; Mammoth, $60,000; while the United States Smelting, Refining and Mining Company, which obtains a part of its income from Utah, has disbursed $506,013.

Indianapolis

May 11—W. D. Ryan, secretary of the Mine Workers' association announces that the miners of the competitive field composed of Illinois, Indiana, Ohio and western Pennsylvania have ratified the wage settlement made at the Toledo convention by a vote of 77,000 to 2428. It is now expected that new contracts will be signed within a short time and the mining industry of these States started on an agreement for the two years ending April 30, 1910.

The Indiana operators and miners are wrangling about four disputed points relating to local agreements. First, it is demanded by the miners that the operators shall be responsible for powder which they sell to the miners after it leaves the magazine until delivered to the men at the mine. The miners insist that the seller of powder should deliver the article sold, and since the operators of Indiana make $300,000 a year profit on the sale of powder they can afford to deliver it. The debate on this point was prolonged, the operators insisting that at the Toledo convention it was agreed there should be no increase in the cost of production. The other points are: fining miners a dollar a day when out on a stampede strike, discharging men for loading dirt with coal and the increase of the day wages of the men at the top of the mines.

Whether or not the fact that a miner curses the officials of the company employing him constitutes sufficient ground for his discharge, made a two days' session of the miners and operators of the Block coal district necessary. Even then no agreement was reached and it was decided to drop the matter for the present. The miners have sent a statement of the case to President Lewis for his decision.

A report on the quantity and classes of coal used in the principal cities of Indiana has just been made by the State statistician with the view of a thorough investigation relative to smoke conditions. As applying to Indianapolis, the report shows that of the 572,620 tons of coal used in the city during 1907 for domestic purposes, only 174,212 tons of smokeless coal was used, viz.: Pocahontas (W. Va.) coals, 81,024 tons; anthracite (Penn.), 80,712 tons, and other classes, mostly coke, 12,476. This report bears out the contention that the smoke nuisance is almost wholly due to the use of smoke-producing coal for domestic purposes. The question is, how can the authorities stop the smoke from chimneys of the residences as well as that from the factories?

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Arizona

COCHISE COUNTY

Tombstone—The large, new pumps have been lowered to the 1000-ft. level, and it is expected that they will be in operation about June 1.

GRAHAM COUNTY

Arizona Copper Company, Ltd.—Production for the month, April, amounted to 1500 tons copper.

PINAL COUNTY

Imperial Copper Company—The new smelting works of this company, at Sasco, are reported to be doing remarkable work from the metallurgical point of view, the loss of metal being extremely low. The plant is of thoroughly efficient design, and the directors of the company feel much gratified respecting its operations.

YAVAPAI COUNTY

Cleopatra—Stoping has begun in the north drift of this mine at Jerome. An electric drill has been installed.

Congress Consolidated—This company, at Congress, is keeping one of its 40-stamp mills in constant operation, and is sending out regular shipments of concentrates and gold bullion. A $4000 bar was shipped as a result of the last 10 days' run of April.

Logan Copper Company—This company has just made another payment to the original owners of the property, but one other payment remains to be paid and the manager of the company states that this payment will be discounted before the time for payment arrives. The company's mines are located near Skull valley in the Copper Basin district.

Empire Consolidates—This company has operated its mill during the past 10 days with very satisfactory results. This initial run was made for the purpose of ascertaining whether or not the recent improvements in the mill would make a proper saving. The company's mines are located on Groom creek six miles south of Prescott. The management states that the mill will be put in constant operations in a few days.

Sink to Rise—It is reported that a good strike has been made at this mine, six miles west of Prescott; a body of quartz carrying gold has been opened to a depth of 30 ft. The ledge is from 2 to 8 ft. wide.

Arizona Power Company—This company is building a large water-power plant on Fossil creek in the eastern part of Yavapai county, the nearest railway and postoffice point being Mayer; about 600 men are now employed. When the plant is completed about 8000 h.p. will be developed. It is proposed to furnish this power to the mines of Yavapai county.

YUMA COUNTY

Dixie Queen—A strike of ore carrying copper and gold is reported from this group near Parker. The body is said to be large.

Arkansas

BOONE COUNTY

National Mining and Leasing Company—This company, of Plainfield, N. J., has purchased the noted lead-mine tract of 80 acres in the Sugar Loaf district. Development work will be pushed.

MARION COUNTY

Franco-American Lead and Zinc Company—This company has appointed Wirt W. Young, resident manager, with headquarters at Yellville. This company has extensive holdings in this district which are to be developed.

California

AMADOR COUNTY

Kennedy—At this mine, Jackson, drifting for the ledge on the 3150 level is in progress. The tramway from the railroad to the mine has been finished.

Argonaut—S. R. Rainsford, of Salt Lake, will now be the virtual superintendent of this property, W. F. Detert remaining as president.

BUTTE COUNTY

Ambisga—At this mine on Post creek in the gravel range, Superintendent Biscom has reached the pay gravel and will set a larger force at work. This is a San Diego, Cal., company.

CALAVERAS COUNTY

Benson—This mine, near Altaville, is to be reopened at once after a shut-down of several months. The three-compartment shaft is down 460 ft., and there is, on the property, a 10-stamp mill, air compressor and hoist.

Boston—Men are repairing the road to this mine, which is to be started up at once.

Chapman—Operations are to be resumed on this mine, near San Andreas, where there is a 150-ton gravel mill.

Hedrick—At this mine, near San Andreas, the sinking of the shaft has been finished and drifting begun. The gravel is paying well.

San Forni—At this property, Garden Valley, a small mill is being erected by Gray & Foster.

Union—The owners of this gravel mine near Placerville have decided to resume work at once.

Wagner—At this mine, recently bought by T. H. & N. Douglas, of Sacramento, arrangements are being made for equipment and development.

INYO COUNTY

Southern Belle Mining Company—Report comes of a new strike in this well known property. Drifting is being pushed at the 400 level.

Skidoo—Frank Thisse is reported as having made a good strike in Nemo cañon at Skidoo. A number of prospectors have gone to the region.

MARIPOSA COUNTY

No. Five Mining Company—On the property of this company, near Hornitos, development work will shortly commence under direction of Richard O'Brien.

NEVADA COUNTY

Bullion—This property has been bonded by Samuel Mills, who is organizing a company to work it as soon as it is unwatered. The mine has been opened to a depth of 1500 ft., and will be sunk 500 ft. deeper. A new compressor is to be put in.

Niagara—Operations have been suspended on this mine on Deer creek. Lack of funds is given as the cause.

Prudential Mining Company—This is the successor of the New York-Grass Valley Mining Company which owns the old Perrin mine at Grass Valley. A. P. Wilson is the new superintendent. Men are cleaning out the mine, putting it in readiness for active work.

PLACER COUNTY

Ora Cobra—This company has begun work at Red Mountain, near Cisco.

Paragon—The old tunnel is being cleaned out and a new track is being laid. The tunnel is low enough to carry the gravel of the Wasson ground on Brushy cañon.

PLUMAS COUNTY

Arcadia—This mine, at Greenville, owned by D. McIntyre, has recently developed a chimney of high-grade ore. The tunnel is now being extended.

Plumas-Mohawk Mining Company—This mine, which has been idle a year or more, is about to resume operations with L. P. Cedarholm as superintendent. The mine has a Huntington milling plant.

SAN BERNARDINO COUNTY

Hart—The Big Chief mine has received its mill, which is now being installed. A new hoist has been put up at the Quartette shaft of the Jumbo. Tunnels are to be driven on the Fairview and Providence groups of the Hart Consolidated Mining Company. On the Sunrise, J. D. Goodwin has made a promising strike. A number of companies are preparing to do extensive development work.

SHASTA COUNTY

Colorado—This mine, at one time known as the Turtle Dove, near Shasta, has been bonded to N. W. Schorell, of Mill Valley.

SIERRA COUNTY

Ophir—This mine, near the Tightner at Alleghany, is yielding rich ore from a shoot recently found. The mine is owned by H. H. Appell, of Sacramento, and Thos. Bradbury is superintendent. The find was made after four years' work.

Papoose—The ledge has been encountered in the new tunnel of this mine and it shows good ore.

SISKIYOU COUNTY

Borden Group—At this mine, Cow creek, owned by Balfrey & Addison, high-grade ore has been met.

California Consolidated—At this group at Rollin 15 stamps are busy crushing ore.

TRINITY COUNTY

Nash—This mine, on Coffee creek, has been leased to R. G. Abrams and others, and 40 men set at work. This hydraulic mine is well equipped.

Bullychoop—At this mine, Jos. Thomas, superintendent, 30 men are at work and 30 stamps have been started. The new gravity tram has been completed.

Deadwood—Six leases are being worked on the old Brown Bear mine at this place, and the mill is running steadily. The Lappin has resumed work after six months' shut-down; the Wiley and Fox mines are being opened up. The West Point Mining Company is about to do extensive development work.

TUOLUMNE COUNTY

The Tarantula, Omega and Western Extension groups at Chinese have been bonded to Mann & Russell. T. J. Russell is superintendent.

Arbona—At this mine, Tuttletown, R. B. Lucas superintendent, new machinery has been installed and the mill is running steadily.

Joe Hooker Mining Company—This Los Angeles company will develop the Wild Cat and Joe Hooker mines on the Calder ranch, first removing the accumulated water.

Colorado

SAN JUAN COUNTY

Frank Hough—At this mine, on Engineer mountain, a new six-drill air compressor is to be installed soon.

Gold King—This mine, at Silverton, has been examined by John T. Judd, of Boston, and D. M. Haynes. It is understood that negotiations are in progress for a sale of the mine.

Little Nation—The building for this mill, near Howardsville, is well advanced, and most of the machinery has been received.

Neoma H—A. O. Egbert, of Lake City, has taken a lease and bond on this mine in Horseshoe basin, and will soon begin work.

SUMMIT COUNTY

Colorado Dredging Company—This company has applied for an injunction to restrain C. W. Snyder and others from diverting the water of Swan river by building a tunnel, or tunnels, above the company's placer ground.

TELLER COUNTY—CRIPPLE CREEK

A severe snowstorm on May 3 and 4 was a serious interruption to work throughout the district. At many mines no attempt was made to work for several days.

Stratton's Independence—General Manager Charles M. Becker has fixed new terms for all leases on this mine. These rules will apply for a period of six months, which is the time limit on each lease to be granted. Each lessee under the new contract is to furnish his own supplies, but the company will supply air and machine drills. For each mine car hoisted the company will exact a charge of $2, but the lessees will be permitted to sort ore under ground, and all low-grade ore can be stored in stopes. The company will also charge 5 and 10c. for sharpening tools per bit. There will be a charge on profits, but before taking this charge each lessee will be allowed $3.75 per shift for each man working after which the deduction on profits will be made as follows: 10 per cent. up to and including $250; 20 per cent. on $500 profits; 30 per cent. on $1000; 40 per cent. on $2000; and 50 per cent. on all profits over $2000. All ore will be shipped to the United States Reduction and Refining Company, under the open rate, which will accrue to the benefit of the lessee, as the treatment and transportation charges under the open rate inaugurated a few months ago by this company are the cheapest ever known in Colorado. The low-grade ore, of which it is expected considerable will be broken down by the lessees, will be handled by the Stratton's Independence Company in the newly constructed cyanide mill.

Idaho

SHOSHONE COUNTY

Sonora—An important strike is reported on the 800-ft. level at this property, the vein uncovered showing a width of 6½ ft. of good milling silver-lead ore. The magnitude of the orebody has not yet been determined.

Hercules—The annual statement filed with the county assessor shows a profit during 1907 of $765,161; this figure is about $22,000 less than the profit shown in 1906. The report shows that the number of tons of ore extracted was 20,466; gross value of the ore, $1,615,684; cost of extraction, $178,038; cost of transportation, $167,374; cost of reduction and sale, $161,719; cost of construction and repairs, $343,392; total cost of operation, $850,523.

Hecla—The report of this mine shows that the total tonnage of ore mined during 1907 was 117,430; gross value of ore taken out, $1,244,685; cost of extraction, $440,283; cost of transportation, $333,349; cost of repairs, reduction and sale, $33,865; total cost of operation, $807,496; profits, $437,189. The profit showed a decrease of slightly over $118,000 as compared with that of 1906.

IDAHO COUNTY

More than 100 stamps are now dropping within a radius of 30 miles in the Orogrande-Dixie-Elk City district, and many more will be added before the close of the season. More gold is now being taken out than at any time in the history of quartz mining in this part of the State. Electric power and railway transportation facilities are being provided and other improvements will follow.

Hogan—This property, which is now owned by the Butte-Orogrande corporation, is preparing to put its 20-stamp mill in operation, and will work 35 men. After a period of idleness extending over two years, the mill is being refitted.

Twin Butte—The mill on this property is ready for operation. The equipment consists of rolls and crushers instead of stamps, the capacity being equal to that of a 10-stamp mill.

Indiana

WARRICK COUNTY

A number of mines in this county are filled with water; the late continuous rains flooded the streams and overflowed the country. The D. T. Scales coal mine operated by the Wooley Coal Company is perhaps in the worst condition. It will be some days before the mines are pumped out and mining operations resumed.

GREENE COUNTY

A difference of a few hours prevented a mine horror at the Vandalia mine No. 9 on May 5. A piece of slate 20 ft. thick and 50 ft. long fell in this mine; the estimated weight of the rock was 20,000 tons.

Had the accident occurred two hours later it would have caught and killed a hundred miners. A number of mules were killed. It will require several weeks to clear the mine.

Kentucky

Bell County

Ralston Coal Company—This company, which has its headquarters at Middlesboro, has secured a lease of 1000 acres on the Stony Fork branch of the Louisville & Nashville Railroad, a few miles above Middlesboro. The company will expend $40,000 in installing mines on the lease. The highest-grade machinery will be purchased and a shaker screen will be installed to make four grades of coal. The Lignite vein, the highest grade of domestic coal, will be operated exclusively.

Hopkins County

Royal Coal Mine—The sale of this mine to J. G. P. Hall was recently noted. He has now sold it to Andrew and William Hogg, of Daniel Boone, and J. M. Cooke and D. P. Ford, of Madisonville. The purchasers, it is stated, will make extensive improvements with a view to increasing the output. They have incorporated the Madisonville Mining Company, of Madisonville.

Knox County

Trosper Coal Company—The lease of coal land held by this company at Trosper has been transferred to Hiram Jones, H. L. Biggs and others, of Trosper. The mines are known as Bennett No. 1, on the Cumberland railroad, and are the largest in the upper Knox county district. The new owners will make material improvements.

Michigan

Copper

Copper Range Consolidated—The option on the Globe property which this company has had from the Stanton interests, has been extended until April 1, 1909. The Champion is completing the work of installing telephones at the various underground levels in the four shafts. The Baltic shafts are equipped with underground telephones.

Ojibway—The crosscut from the 350-ft. level of No. 2 shaft is within a few feet of the calculated distance to the lode and from the character of the formation in the breast of the crosscut it is believed it will be reached at 70 ft. In sinking No. 1 shaft considerable water was encountered and sinking had to be temporarily suspended; all work was directed toward sinking No. 2 shaft to the required depth and this was accomplished much sooner than originally planned. This crosscut will give the first view of the formation, other than shown by the drill cores, because both shafts are going down in the footwall. In sinking No. 1 shaft several small fissure veins were cut. These were well charged with copper. The electrical apparatus for the generating station is on the ground and is being rapidly assembled. This power will be used for various purposes, including driving the hoisting drums at No. 1 shaft.

Seneca—The first shaft to be put down on this property has been started and will be sunk in the footwall, 60 ft. behind the lode. The ledge was reached on the shaft-site about 7 ft. from surface. This tract has been fully explored both by diamond drill cores and trenches and a good working knowledge of the formation has been obtained.

Lake—The third drill has gone into commission and a more aggressive policy will be adopted. The formation in the breast of both drifts continues in the same rich copper-bearing ground. It is possible that this property will enter the producing stage much sooner than is generally expected; the stock pile contains rich stamp rock.

Superior—The shaft on this property is down below the ninth level and crosscutting to the lode at that point is now under way. In drifts extending from the upper levels good stoping ground is being blocked out.

Michigan—Work was suspended on the stamp mill at Keweenaw Bay last fall, but now it will be rushed to an early completion. At the mine "C" shaft continues to show encouraging results and sinking is going on below the eleventh level. "A" shaft is also showing well in the lower drifts and sinking has been resumed.

Hancock—An assessment of $3 per share has been called on the outstanding 100,000 shares of this company's stock. This is due in three installments, and will make a total of $13 paid per share. The company is capitalized at 200,000 shares, par value $25, 100,000 shares remaining unissued. In all probability the mine will be in a position to begin rock shipment to a stamp mill during the summer. No. 1 shaft has a large stock pile of good stamp rock and good stoping ground is being opened up. No. 2 shaft is down approximately 750 ft.; the Mineral Range railroad has begun work on the spur to be run to the shaft site.

Keweenaw—The stamp mill is to be overhauled and put in shape to handle a mill test, which is to be run early in July on the Medora-shaft rock. Developments at the mine continue favorable, especially in the lower levels. The shaft is sinking close to the 13th level, and when that point is reached, drifting will be started, as the levels with the odd numbers are used as main drifts. With the amount of stopping ground blocked out and with the aid of the stock pile it is believed that the mill can be kept in continuous operation. A short spur will have to be run to the shaft site and the gage, running into the mill, must be widened; but in either case the distance is short and very little time will be needed to complete this work. The material for the railroad from Mohawk to Calumet is on the ground and this line should be completed early in June.

Montana

Butte District

The past week has been an uneventful one in Butte. Little or no building or improvements of any character have been begun on the smaller independent properties; in fact, but few of them are carrying on operations. Practically all of the leasers who were engaged in working the silver and copper ores in the camp have been forced to quit because of their inability to make the mining pay. The one notable exception is the Lexington mine, where the leasers continue to work. The operating mines of the Amalgamated company are in full swing. Since the shutdown of last September there has been a noticable increase in the efficiency of the work done per man, and this has resulted in a material decrease in the cost of mining. This increase in efficiency is directly traceable to the fact that there are a great number of experienced miners out of work in the camp and the foremen are thus able to secure competent men. Contrary to the general expectation, the output of the Boston & Montana mines has not been materially affected by the disastrous flood which resulted from the breaking of the power dam at Hauser lake. The smelter at Great Falls was practically uninjured, and the tracks of the Great Northern Railway, which connects Butte and Great Falls, have been replaced for the entire 26 miles of the washout.

North Butte—The mines of this company have broken all previous records by producing approximately 4,000,000 lb. of copper during the month of April. The output for March was 3,500,000 lb. The mine is being worked to its full capacity, and between 1300 and 1500 tons of ore are being hoisted daily.

East Butte Mining Company—The trial of the action brought against this company by the South Butte Mining Company is nearing the end in the District Court in Butte. The South Butte Company claimed that the former company had extracted ore from the South Butte property of the value of $100,000, and the suit is brought to obtain damages for that amount and also for a permanent injunction to prevent the East Butte company from further mining in the disputed territory.

Butte Coalition—The Tramway shaft is now down about 1400 ft. Through the shaft of this claim, which adjoins the Minnie Healy, the rich orebodies on the lower levels of the latter mine are to be worked. The upper levels of the Minnie Healy have been abandoned for some 10

months on acount of the fire which is still smoldering in the old stopes, and which it is apparently impossible to extinguish. The shaft of the Rarus is now down to the 18th level, where a station has been cut and a crosscut started for the lead. While the lowest level is known as the 1800, the distance from the surface is in reality 2200 feet.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Production—The total production for the week ending May 2 amounted to 1682 tons of ore, having a value of $114,400. The Combination mill received 630 tons; the Western Ore Purchasing Company, 731 tons, and the Nevada-Goldfield Reduction Company, 321 tons. Purchases by the Nevada Goldfield Reduction Company were: Jumbo New Fuller No. 7, 186 tons; Combination Fraction, 36 tons; Garrett lease on Kendall, 19 tons; Begole Syndicate, 80 tons; total value, $12,950. Bought by Western Ore Purchasing Company: Wingfield dump on Florence, 380 tons; Little Florence, 24; Florence Annex, 35; Rogers-Syndicate, 210; Florence Consolidated Mining and Leasing, 16; Baker lease on Sandstorm, 21; Florence Gem, 11; Daisy, 30; Great Bend, 31; Baby Florence, 30; Waterman sub-lease on Sandstorm, 15; total value, $73,100.

Great Bend—This company has been making shipments recently which average $125 per ton.

Little Florence—The lease expired April 26, but the ground passed immediately to the New York Florence Leasing Company, which will begin sinking at once and will push work vigorously during the six months the lease has to run. Pending the settlement of the litigation between the parent company and the old Little Florence, it is probable that nothing will be touched above the 500-ft. level. Charles G. Gates, of New York, is behind this new company.

Mushett Lease—This lease on the Miss Jessie claim of the Laguna is proving up its new strike most satisfactorily. The vein has been proved up for 71 ft. on the 430-ft. level and an upraise shows even better ore. That in the drift breaks without sorting $131 per ton; $29 of this is in silver, which is a novelty for this camp.

Simmerone Mining and Leasing Company—This company has resumed operations. The lease has a shaft 265 ft. deep, 300 ft. of lateral work, and has produced about $5000 worth of ore.

NYE COUNTY—BULLFROG

Production—The output of Bullfrog mines for the month of April amounted to $170,850; of this, Montgomery-Shoshone produced $129,500; Keane Wonder, $30,000; Diamond Queen, $9000; Original Bullfrog, $350; and the Lemle lease on Bullfrog Mining, $2000.

Homestake—A six-drill compressor purchased from the Red Oak property will be ready for operation in a few days, when mining will be resumed. The 25-stamp mill is expected to be in operation early in June.

Tramp Consolidated—A carload of high-grade ore has been shipped to Utah. The ore is from the drift between the Tramp and Eclipse shafts. Besides this high-grade ore a large amount of milling ore has been broken in the course of development.

West Extension—A lease 400x400 ft. in the vicinity of the original prospect shaft has been let to Peter Vuich and T. Swraka to run one year. Work on company account is developing bodies of milling ore. Ore from an 8-in. streak is being sacked for shipment.

NYE COUNTY—MANHATTAN

Nevada Ore Reduction and Refining Company—This company has a five-year lease on the Stray Dog, the Indian Camp and Jumping Jack properties. Pipe lines connecting the Jumping Jack and the Stray Dog shafts with the mill have been completed to furnish a supply of water by gravity.

NYE COUNTY—TONOPAH

Production—Ore shipments over the Tonopah & Goldfield Railroad for the week ending May 2 to the Western Ore Purchasing Company, consisted of 230 tons from the Tonopah Extension. The Tonopah company sent 2300 tons, the Belmont company 580 tons, the Montana-Tonopah 1100 tons, the Jim Butler 240 tons, the Midway 400 tons, the West End 60 tons and the MacNamara 153 tons to the mills, making the total shipments for the week 5063 tons, of an estimated value of $110,460.

Belmont—The mill is working 55 of the 60 stamps. The ore output is limited, because most time and attention is given to development and prospecting. A total of 278 ft. of new work was accomplished during the week ending May 2. Every week adds greatly to the reserves, and there is an enormous block of ground still to be developed.

MacNamara—About 51 tons of ore is now shipped every two days. The work is confined to the workings in the western part of the mine on the 300-ft. level about 600 ft. west of the shaft. Stoping continues in No. 3 raise from the main west drift, where about 5 ft. of milling ore is extracted. Underhand stoping has been started on this orebody. The stopes from the south crosscut are up 30 ft. and are carried with a 25-ft. breast.

Montana—The mill treated during the week ending May 2, 1100 tons of ore, the extraction for that period being 93 per cent. In the mine recent development has added considerably to the ore reserves. The drift on the 462-ft. level on the MacDonald vein has followed the vein for 45 ft. and has exposed 6 ft. of rich ore, which is mixed with lower grade from the dumps. Preparations are being made to start new stopes on this orebody.

Tonopah—The compressor has been repaired and development work is again in full swing. In the western drifts on the Valley View vein in the Silver Top claim, the veins are showing a marked improvement. At the mill 95 of the 100 stamps have been dropping, crushing 3100 tons of ore carrying an average of $22 per ton. Shipments during the week included 60 bars of bullion and 35 tons of concentrates, of a total value of $64,500. The mill makes an average extraction of a little more than 90 per cent.

Tonopah Extension—The orebodies recently uncovered on the 550- and 600-ft. levels are improving steadily. On the 550 the east and west drifts have opened the vein for a distance of 160 ft. The character of the ore is changing somewhat from the oxidized mineral to sulphides, showing considerable ruby and brittle silver.

STOREY COUNTY

The following items are from reports of superintendents in different Comstock mines for the week ending May 2:

Ophir—In the north stope on the 2100 level, on four levels, 177 mine cars of ore were extracted, assaying $33.51 per ton. The northeast sill floor drift was advanced 7 ft. in the vein, the face showing quartz of low assay value. The 2200 level yielded 40 cars, assaying $73.51 per ton, and 163 cars of $32.86 per ton.

Yellow Jacket—From the 900, 1000 and 1100 levels of the mine and from the surface drift 1101 tons of fair-grade ore was extracted and milled; 86,000 lb. concentrates were shipped to the Selby smelting works.

Silver Hill—Prospecting continues on the different levels. During the week, 65 mine cars of ore were extracted, assaying about $14 per ton.

WHITE PINE COUNTY

Steptoe Valley Works—Although the first unit of the mill was put in operation in April, the work so far has been only of a tuning-up character. Regular operation will begin about the end of May. The smeltery is expected to go into operation toward the end of June.

North Carolina

MONTGOMERY COUNTY

Iola Gold Mine—This mine continues to be a large producer. Operations are to be pushed, under the management of Capt. Richard Eames, Jr., of Salisbury.

New Mexico

GRANT COUNTY

Philadelphia—A surface equipment including boilers, hoist, compressors and

drills will be installed at this copper mine at Hanover during the summer. It is expected that regular daily shipments will begin within 60 days.

Minneapolis—A contract has been let for driving a 100-ft. adit to connect with the shaft. No work has been done on the property in recent years.

SOCORRO COUNTY

Deadwood—This mine at Mogollon which has been idle for some time has resumed operations. The property is only a few hundred feet from the Last Chance mine and is on the same ledge.

Oklahoma

OTTAWA COUNTY

Buckeye—An interest in this mine at Miami has been sold by A. M. Wagner, of Webb City, Mo., to F. L. Garrison, representing the Queen City-Joplin Mining Company.

Dan Osely Mine—Chicago men have secured a lease of this mine, and will erect a mill.

Pennsylvania

ANTHRACITE COAL

Temple Iron Company—An explosion in this company's Lookout colliery at Wyoming, on May 12, killed seven miners and injured 12 others. It is said that a miner allowed a small gas feeder in a gangway to burn, which set fire to the timbers. When the fire-boss found this, he summoned a party and was trying to extinguish the fire, when the explosion occurred.

Clarence—The breaker and other buildings of this colliery at Yatesville were recently destroyed by fire, which was caused by lightning striking the breaker. The colliery is owned by the Erie.

Philadelphia & Reading Coal and Iron Company—This company's statement for March and the nine months of its fiscal year from July 1 to March 31 is as follows:

	March.	Nine Mos.
Earnings	$1,603,782	$28,407,863
Expenses	1,648,473	26,350,303
Net or deficit	Def. $ 44,691	Net $ 2,057,560

For the nine months there was an increase of $518,780 in earnings, a decrease of $68,426 in expenses; and a gain of $587,206 in net earnings.

BITUMINOUS COAL

Westmoreland Coal Company—This company last year planted 50,000 black locust seedlings on its property at Export, near Irwin. This spring it is setting out 50,000 young catalpa trees. The object is to secure a future supply of posts for mine timbering.

Pittsburg Coal Company—This company's statement for the three months ended March 31 is as follows:

	1907.	1908.	Changes.
Net earnings	$1,025,429	$ 515,992	D. $ 509,437
Charges	698,099	641,381	D. 56,718
Surp. or def.	$327,330	D. $ 125,389	.....

Charges this year were made up as follows: Depreciation of coal lands, $120,244; depreciation of plant and equipment, $257,837; interest, $263,300. There was a decrease of 24.5 per cent. in coal mined this year.

South Dakota

LAWRENCE COUNTY

American Eagle—The mill will be ready to commence operations some time this month and will treat 100 daily at the beginning.

Golden Reward—A series of tramways are being constructed from the tunnels in Nevada gulch and the output is thus being increased.

Portland & Clinton—High-grade shipments to Denver continue. The average value of the ore now being mined and shipped is high in gold and the vein is widening with development.

Dividend—The small cyanide plant is handling 25 tons daily at a fair profit and the work of development is showing up well.

Snowstorm—John Hawgood is developing a vertical from which some high-grade ore has been taken. In the lower tunnel the orebody is 35 ft. wide; the ore is of milling grade.

Utah

JUAB COUNTY

Bullock—A special meeting of shareholders will be held in Salt Lake, May 14, to consider the matter of increasing the capital stock from 300,000 to 600,000 shares. The company has arranged for the purchase of six additional claims.

Crown Point—Development work has been suspended for a time owing to the Colorado Mining Company having refused to supply power from its compressor.

Colorado—Two new compressors have been received at this mine and are in process of installation. It will require two motors of the aggregate capacity of 300 h.p. to operate them.

May Day—This mine and mill are in operation again, the product being shipped to the Murray smelter of the American Smelting and Refining Company.

Yankee Consolidated—The new shaft is down 900 ft. Drifting is now in progress on this level.

SALT LAKE COUNTY

Bingham Central Standard—Ore shipments have been inaugurated from this property.

United States Smelting, Refining and Mining Company—The lead smeltery at Salt Lake is expected to resume operations about July 1. Owing to its idleness at present the refinery at Grasselli, Ind., is also closed.

SUMMIT COUNTY

Park City Shipments—The output last week amounted to 1311 tons, the contributing mines and amounts being: Daly-Judge 320; Silver King, 939; New York Bonanza, 52 tons.

Silver King Consolidated—Development work will be inaugurated at this property during the coming week.

Uintah Treasure Hill—Work has been resumed at this property and it is expected that it will soon be shipping again.

Silver King Coalition—The management is preparing to conduct a more vigorous campaign in both development and ore production.

Daly—Production will begin from this mine as soon as the Ontario adit is opened.

TOOELE COUNTY

Consolidated Mercur—The April earnings of this company were about $65,000. The mill is handling about 800 tons per day.

Wisconsin

ZINC-LEAD DISTRICT

Highland—The principal mines in this camp are producing again, although no oxide ores are as yet being sent out; the Franklin and Minter, producers of oxide ores exclusively, are both mining and expect to begin milling and shipping as soon as the oxide plant of the Mineral Point Zinc Company starts up again. The St. Anthony, with new mill equipment, has resumed work. The Highland Mining Company is working a full crew. The Wallace is also active. The Red Jacket and Centerville are preparing to resume.

Linden—All of the mines are active at this camp again, excepting the Robert and the Mason; the latter is owned by the Mineral Point Zinc Company and is expected to start soon. The list of present shippers includes the Dark Horse, Ross, Glanville, Stevens and Platteville-Linden. The Rajah company is installing a heavier pumping outfit, in order to complete the shaft which has just penetrated the upper ore level.

Rewey-Mifflin—The Coker, Sunrise, Gruno, Peacock and Slack are producing and shipping. The Coker, owned by the Mineral Point Zinc Company, is one of the oldest producing jack mines in the district and is now turning out more ore than at any time in the last 25 years of its history; its shipping point is Livingston. The Dodger and the Squirrel are opening up two promising prospects; the Squirrel has a rich sheet of almost solid jack 16 in. thick, making on a due east and west range and separate and distinct from the old workings; negotiations are being made to erect a concentrator. The D. D. C. company has foundations in and some of the material assembled for the erection of a 50-ton mill. Harker is the shipping point for the mines in the Mifflin camp.

Canada

ONTARIO—COBALT DISTRICT

Ore Shipments—Shipments of ore for the week ending May 2 were as follows: City of Cobalt, 110,520 lb.; La Rose, 132,200; McKinley-Darragh, 60,900; Nipissing, 64,030; O'Brien, 126,980; Trethewey, 192,800; total, 687,430 pounds.

City of Cobalt—On May 1 a rich vein, 2 to 4 in. wide, was encountered 80 ft. in the drift at the 137-ft. level. The shaft is down 155 ft. and four drifts have been run at the 65- and 137-ft. levels. Four drills are in operation which are supplied with air by the Cleveland Cobalt company.

Foster-Cobalt—The main shaft is down 210 ft. and a drift will be started at this level. Extensive drifting has been done at the 140-ft. level; the south drift, on vein No. 8 has been carried toward the University line for 210 feet.

Temiskaming—At a depth of 200 ft. the vein has widened to 8 in. of rich ore.

ONTARIO—MANITOU LAKE DISTRICT

Paymaster—The crosscut at the 300-ft. level has exposed 50 ft. of gold-bearing vein.

ONTARIO—MONTREAL RIVER DISTRICT

Bruce Claim—At this mine, in James township a vein 4 in. wide at 4 ft. depth shows smaltite and native silver. About 400 ft. of stripping has been done.

Cragg Location—The main shaft at this mine in Smythe township is down 50 ft., and 300 ft. of crosscutting has resulted in encountering five veins, which show good ore. The shaft is sunk on a vein of barite, calcite and smaltite with native silver. The silver content is increasing with depth.

ONTARIO—TEMAGAMI RESERVE

Northland—At this sulphur-ore mine at Rib lake, work has been going on for two years in charge of Ronald Harris. A new plant comprising a 13-drill compressor and two 100-h.p. boilers is in operation. Shaft No. 1 is down 160 ft., with two levels at 50 and 100 ft. At both of these levels considerable drifting has been done and a large quantity of ore has been blocked out. Thirty-five tons of ore are shipped daily to Buffalo, which average about 43 per cent. sulphur; the vein that is being worked averages 4 to 8 ft. in width. There are several good veins on the property.

ONTARIO—MANITOU LAKE DISTRICT

Laurentian—The 20-stamp mill is in steady operation at this gold mine. Much of the ore which is being crushed comes from the 400-ft. level.

NOVA SCOTIA

Dominion Coal Company—The output of coal for April was 316,384 tons, as compared with 298,743 tons for April, 1907, an increase of 17,641 tons.

Dominion Iron and Steel Company—The conferences recently held between President J. H. Plummer, of this company, and President James Ross, of the Dominion Coal Company looking to a friendly adjustment of the protracted dispute between the companies, have apparently led to no practical results. The Coal company was disposed to admit its liability for damages for breach of contract, but was not willing to pay $2,903,231 claimed by the Steel company. This amount includes $1,804,232, a sum in excess of the contract price paid to the Dominion Coal Company for supplies under a temporary agreement pending the decision of the case. The Coal company proposed to fix the damages at $1,250,000, which was not acceptable to the Steel company; whereupon negotiations were broken off. It now seems that a resort to the Imperial Privy Council on an appeal against the judgment of the Nova Scotia courts in favor of the Steel company will be inevitable.

Mexico

CHIHUAHUA

Dolores and La Insurgente—The litigation involving these two properties in the Santa Eulalia district has been settled by combining the interests of both companies into a new corporation to be known as La Insurgente, S. A. About two pertenencias of the Dolores holdings were claimed by the Insurgente company. The shares of the new company will be divided according to a plan agreed upon.

Madero Lead Mine—The Madero Brothers, members of the family which controls the smelting works at Torreon, are said to be developing a large body of lead ore on their property near Cuchillo Parado on the Conchos river. The ore carries a high percentage of lead and a little silver.

Candelaria Mining Company—This company has unwatered its mine in the San Pedro district by means of an air-lift pumping plant, and is shipping 1000 tons of ore monthly.

Cigarrero—Another rich strike is reported in this mine at Almoloya. Shipments from the mine amount to 100 tons daily. The company's railroad to Baca station on the Parral branch of the Mexican Central is operating satisfactorily, also the 4000-ft. incline from the mine to the ore bins.

DURANGO

Luster Mining Company—This company has three copper furnaces running regularly at Magistral handling about 500 tons of ore daily. The producer-gas plant is said to produce power at the rate of 2c. per horse-power hour.

HIDALGO

Guerrero Mill—This 40-stamp cyanide mill of the Real Del Monte company at Pachuca, which was started on April 25, with appropriate ceremonies, is working satisfactorily. The ore is concentrated on tables, reground in tube mills and treated in agitator tanks. The mill is operated by electric power throughout.

JALISCO

Tenamache—A body of high-grade silver and gold ore has been opened in developing the Platanitas vein in this mine in the Tepic territory. The ore is being sacked for shipment through the Pacific port of San Blas. The erection of a 30-ton mill is contemplated for the treatment of low-grade ores.

Chatterton—The stamp mill of this company in the Tapalpa district is producing about four tons of concentrate daily. A cyanide annex will probably be added.

Europe

RUSSIA

The following semi-official statement of gold delivered to the various assay offices and mints in Russia during the year 1907 has been compiled and published:

	Poods.	Kilograms
By mine-owners	1,172.162	19,200.014
By lessees and others	591.733	9,692.587
Total, goverment office	1,763.895	28,892.601
Through banks	449.877	7,368.985
Total official deliveries	2,213.772	36,261.586
Total value		$24,097,637

It has been customary, in computing Russian gold production, to add 10 per cent. to the official returns to compensate for gold mined by individual prospectors, stolen, or otherwise escaping official record. Some mining engineers, who have had experience in Siberia, think this allowance too low; but it seems to be, at any rate, conservative. Adding this sum would make the total value of the gold production last year $26,507,400; equal to 1,282,409 oz. fine gold. The value reported in 1906 was $22,469,432, showing an increase last year of $4,037.968, or 18 per cent.

Africa

TRANSVAAL

The gold production for April is reported by cable at 565,832 oz. fine, being 9069 oz. less than in March, but 28,813 oz. more than in April, 1907. For the four months ended April 30, the total was 2,106,696 oz. in 1907, and 2,242,992 oz.—or $46,362,645—in 1908; an increase of 136,296 oz. this year. Allowing for the extra day in March, there was really no falling off, the daily averages having been 18,545 oz. in March, and 18,861 oz. in April; an increase of 316 oz. in the latter month.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, May 13—The anthracite trade seems to be the only section of the coal trade which is at all active. The April production was large and for the four months the shipments, as shown below, were almost as large as in 1907.

The Seaboard bituminous trade is quiet, and the demand for steam coal is light, almost everywhere. There is no present indication of improvement.

In the West wage settlements are being gradually completed in the various districts. The demand for coal is moderate, however, and mines are not being pushed.

The Lake trade is just beginning to open, and little has been done yet, although navigation is entirely open. It looks as if large shipments will not begin before June.

COAL TRAFFIC NOTES

Tonnage originating on Pennsylvania railroad lines east of Pittsburg and Erie, year to May 2, in short tons:

	1907.	1908.	Changes.
Anthracite	1,862,324	1,798,691	D. 63,633
Bituminous	12,737,790	10,886,619	D. 1,851,171
Coke	4,797,723	2,326,077	D. 2,471,646
Total	19,397,837	15,011,387	D. 4,386,450

Total decrease this year, 22.6 per cent.; decrease in coke, 51.5 per cent.

Coal tonnage, Chesapeake & Ohio Railway, nine months of fiscal year from July 1 to March 31, short tons:

	Coal.	Coke.	Total.
New River	4,349,850	153,812	4,503,662
Kanawha	3,657,742	70,645	3,728,387
Kentucky	216,522	.....	216,522
Connecting lines	133,886	49,592	183,478
Total	8,358,000	274,049	8,632,049
Total, 1907	7,290,192	326,327	7,616,519

Deliveries this year: Points west of mines, 4,178,546 tons coal and 178,104 coke; points east, 1,259,581 tons coal and 95,945 coke; line points, 19,693 tons anthracite; tidewater, 2,900,180 tons coal.

Anthracite shipments in April are reported at 5,987,221 long tons, an increase of 70,638 tons over April, 1907. For the four months ended April 30 the shipments, by companies, were as follows, long tons:

	1907. Tons.	1907. Per Ct.	1908. Tons.	1908. Per Ct.
Reading	4,201,935	20.0	3,911,998	18.7
Lehigh Valley	3,597,766	17.2	3,500,040	16.8
N. J. Central	2,685,379	12.8	2,735,067	13.1
Lackawanna	3,378,544	16.1	3,176,498	15.2
Del. & Hudson	2,071,803	9.9	2,279,469	10.9
Pennsylvania	1,932,548	9.2	2,023,907	9.7
Erie	2,214,838	10.6	2,337,552	11.2
N. Y., Ont. & W.	893,244	4.2	910,880	4.4
Total	20,976,057	100.0	20,875,411	100.0

Increases were 49,688 tons on the New Jersey Central; 207,606 on the Delaware & Hudson; 91,359 on the Pennsylvania; 122,714 on the Erie; 17,636 on the Ontario & Western. Decreases were 289,937 tons on the Reading: 97,726 on the Lehigh Valley; 202,046 on the Lackawanna. The total decrease was 100,646 tons, or 0.5 per cent.

New York

ANTHRACITE

May 13—Prepared sizes continue active and the demand is good. Among the small steam sizes pea coal is in good demand, but the other sizes are inactive and in large supply. The large operating companies have closed down their washeries, and this should have a good effect on steam coal. Dealers look for a smaller volume of business for a week or 10 days and then a rush to take on coal before the monthly advance. Prices are as follows: Broken, $4.35; egg, stove and chestnut, $4.60; pea, $3.25@3.50; buckwheat No. 1, $2.35@2.50; buckwheat No. 2 or rice, $1.65@2; barley, $1.35@1.50; all f.o.b. New York harbor.

BITUMINOUS

Dullness prevails throughout the bituminous coal trade and the outlook is not at all encouraging. Some of the principal consuming territories seem to be indifferent whether or not any coal is received. This condition prevails in the far East, in New England and in New York harbor. Good grades of steam coal can be bought for $2.50@2.55 per ton in New York harbor. There seems to be a demand for slack coal and many inquiries have been received from cement makers; recently there was an inquiry for 25,000 tons of slack.

Transportation from mines to tide is fair and cars are in abundance. In the Coastwise coal trade small vessels are chartering to some extent, but large vessels are tied up. Freight rates are as follows: From Philadelphia to Boston, 55@60c.; to Salem and Lynn, 65@70c.; Portsmouth, 65c.; Saco, $1 and towage; Bath, 70c.; Gardiner, 75c. and towage; Bangor, 75@80c.; Sound points, 50@55c. These rates are for large vessels.

Birmingham

May 11—Coal operations in Alabama have been improved by the resumption of operation during the past week of two mines, one in the Pratt mines division of the Tennessee company and the other out in the State. The tipple and boiler house of mine No. 1, of the Little Cahaba Mining Company, at Piper, in Bibb county, was destroyed by fire the last part of the past week and work at that place will be suspended. The output at this mine is over 500 tons. Coal production in Alabama is off over 40 per cent.

Chicago

May 11—With the resumption of mining in Illinois the local coal market is expected to swing back to its normal condition within a week, or 10 days. In the last week the great demand for fine coals was met by increased prices on screenings from Indiana mines and the few Illinois producers. Lump coal has been at a discount and run-of-mine remained about stationary, with demand rather light. Eastern coals generally have been light sellers. Contract business has somewhat improved, and domestic coals, both bituminous and anthracite, have had fairly good business.

Indiana and such Illinois coals as have been in the market have brought $1.75@2.15 for lump, $1.70@1.90 for run-of-mine, and $1.60@1.75 for screenings. Brazil block has been quiet at $2.60@2.70.

Of coals from east of Indiana, Hocking is strongest, at $3.15, no surplus being in local yards. Smokeless is in large supply and relatively small demand, at $2.90@3.15; Youghiogheny finds a light open-market sale at $3.20 for ¾-in. gas coal.

Anthracite sales are light and lake coal is needed to keep up even the present volume of buying.

Pittsburg

May 12—Operations of the railroad coal mines are a trifle heavier this week as shipments to lake ports for the northwestern markets have begun. Fully 40 per cent. of the mines in the Pittsburg district are running. All the river mines are in operation, and enough empties have been returned to warrant steady operations for some time. The rivers are still navigable and most of the coal loaded in the pools and harbor has been cleaned out. Prices on contract remain firm on the basis of $1.15 for mine-run coal at mine. Slack is plentiful and the maximum quotation is 75c.

Connellsville Coke—Prices of standard Connellsville coke are weaker. One sale of 3000 tons of furnace coke was reported early in the week at $1.50, but later sales were at $1.55, which now seems to be the minimum. On contract no sales are being made at less than $1.80. One of the large independent producers is holding

its price of fine foundry coke at $2.25 a ton and is booking some business, but most of the business taken by other producers for spot shipments is at $2 and in some instances less. On contract $2.25 is not known to have been shaded. The operations in the two Connellsville fields continue to be about one half of the 37,000 ovens. The *Courier* in its weekly report gives the production in both regions at 166,175 tons. Shipments 6162 cars distributed as follows: To Pittsburg, 2284; to points west of Connellsville, 3441; to points east of Connellsville, 437 cars.

Foreign Coal Trade

Exports of fuel from the United States for the three months ended March 31, long tons:

	1907.	1908.	Changes.
Anthracite	469,463	422,865	D. 46,598
Bituminous	1,784,653	1,816,584	I. 61,931
Total coal	2,254,116	2,269,449	I. 15,333
Coke	205,907	209,152	I. 3,245

Exports do not include coal furnished to steamships. Canada took this year 1,536,319 tons, or 67.7 per cent. of the total.

Imports of fuel into the United States for the three months ended March 31, long tons:

	1907.	1908.	Changes.
Anthracite	.....	15,023	I. 15,023
Bituminous	491,298	483,635	D. 7,663
Total coal	491,298	498,658	I. 7,360
Coke	44,777	39,545	D. 5,232

Imports were chiefly on the Pacific Coast. Canada supplied 311,956 tons coal and nearly all the coke; Australia, 146,248 tons coal.

Production of coal in Germany for the three months ended March 31, metric tons:

	1907.	1908.	Changes.
Coal	35,410,498	37,697,874	I. 2,287,376
Brown coal	14,904,190	16,604,727	I. 1,700,537
Total mined	50,314,688	54,302,601	I. 3,987,913
Coke made	5,237,732	5,471,331	I. 233,599
Briquets made	3,777,140	4,419,351	I. 642,211

The larger part of the briquets are made from brown coal, or lignite.

The production of coal in Servia, including lignite, was 183,190 metric tons in 1906, and 184,401 in 1907; an increase of 1211 tons.

Iron Trade Review

New York, May 13—The markets are still uncertain and weak. Some inquiries for pig iron have been received, but do not seem to go as far as the order stage. Southern iron still has the call so far as actual sales are concerned. Neither buyers nor sellers will say much about prices.

Following the meeting in New York last Thursday and Friday the following statement was issued from the Steel Corporation office: "Owing to the fact that much erroneous information has been disseminated concerning the purpose of this meeting of pig-iron and ore producers, it is thought desirable to make a statement which embodies the views of all present.

"The meeting was called to hear reports from blast-furnace interests of all sections of the country in regard to general conditions as affecting particularly the foundry-iron trade. Prices of pig iron were only incidentally referred to. There is no agreement to maintain the price of pig iron. Prices are now $8 or more below the high-water mark of eight months ago, and are almost without exception below the cost of production at Northern and Eastern furnaces, and with the exception of a favored few, below cost at Southern furnaces.

"Producers of Lake Superior ore are materially curtailing production, and from information received it is believed the price of ore for this reason will not be reduced below the price of last year."

The last paragraph may be interpreted as a warning to the merchant furnaces.

In finished material, some structural contracts have been let, mainly small; but in other lines business is dull. Iron bars are still sold at cut prices. The steel makers will meet in New York next week, when prices will be discussed.

It is reported that some large interests intend to enforce the contracts still pending, which were made last year. This may lead to some litigation, especially if makers insist on deliveries.

Pig-iron Production—The reports of the furnaces show that on May 1 there were 142 coke and anthracite furnaces in blast, having a total weekly capacity of 262,900 tons. This is 2000 tons less than on April 1, but 30,300 tons more than on Jan. 1. It is 261,600 tons less than on May 1,1907. Taking the estimates made by the *Iron Age* and making allowance for the charcoal furnaces, the production of pig iron in the United States in May was 1,163,700 tons; for the four months ended May 31 it was 4,574,700 tons.

Iron and Steel Exports—Exports of iron and steel, including machinery, from the United States for March, and the three months ended March 31, are valued as below by the Bureau of Statistics of the Department of Commerce and Labor:

	1907.	1908.	Changes.
March	$16,412,616	$15,165,910	D.$1,246,706
Three months	44,686,594	42,878,987	D. 1,807,607

Leading items of export for the three months, in long tons:

	1907.	1908.	Changes.
Pig Iron	20,135	6,750	D. 13,385
Billets, ingots & blooms	30,861	50,505	I. 19,644
Bars	20,540	15,836	D. 4,704
Rails	72,712	35,241	D. 37,471
Sheets and plates	31,220	24,223	D. 6,997
Structural steel	30,666	33,539	I. 2,873
Wire	38,035	35,766	D. 2,269
Nails and spikes	13,697	12,130	D. 1,567

Billets and structural steel were the only items showing increases.

Iron and Steel Imports—Imports of iron and steel, including machinery, from the United States for March and the three months ending March 31, are valued as follows:

	1907.	1908.	Changes.
March	$3,702,660	$1,696,800	D. $2,005,260
Three months	10,019,108	5,461,091	D. 4,558,017

Leading items of imports for the three months, long tons:

	1907.	1908.	Changes.
Pig iron	154,679	36,232	D. 118,447
Scrap	4,053	1,510	D. 2,543
Ingots, blooms, etc.	4,501	2,242	D. 2,259
Bars	8,412	9,927	I. 1,515
Wire-rods	4,271	3,092	D. 1,179
Tin-plates	12,649	15,482	I. 2,833

The only increases were in bars and tin-plates.

Iron Ore Movement—Exports and imports of iron ore in the United States for the three months ended March 31, are reported as follows, in long tons:

	1907.	1908.	Changes.
Exports	1,692	20,628	I. 18,936
Imports	264,896	208,820	D. 56,076

Imports of manganese ore were 50,069 tons in 1907, and 71,894 in 1908; an increase of 21,025 tons.

Baltimore

May 11—Exports for the week, besides copper, which is reported elsewhere, included 65,100 lb. spelter to Liverpool. Exports of iron and steel included 207,229 lb. wire, 130,480 lb. steel nails, and 81,600 lb. pipe.

Birmingham

May 11—Southern pig-iron manufacturers insist that they are selling about their make. The blowing in of the new furnaces of the Birmingham Coal and Iron Company, the blowing out of the old furnace of the same company, and the blowing in of city furnace No. 1, by the Sloss-Sheffield company, were events of note the past week. It is estimated that a difference of at least 300 tons a day is made in the iron production. There is no complaint heard at all as to delivery, the railroads giving every service that could be asked for. The furnace companies assert that quotations range in the Southern territory between $12 and $12.50 per ton, No. 2 foundry. Rumors are still heard that some interests in this section have been disposing of their product at $11.25 per ton, No. 2 foundry, but there is no verification of this.

Chicago

May 11—Conditions in the local iron market show improvement. The demand for pig iron was larger in aggregate amount and size of some individual orders than in any previous week for several months. Inquiries are also for much larger amounts. The bulk of the actual business, however, is in small lots of foundry iron.

Southern iron brings $11.50@12, Birmingham ($15.85@16.35, Chicago) on known sales, and there is gossip about lower prices. The rumors of $10 Birmingham iron have not to any extent

affected the market, and Northern iron holds to $17, with perhaps a shading of 25 or 50c. on desirable contracts. Northern charcoal iron sells steadily in small lots for $20@20.50.

Philadelphia

May 13—Improving financial and crop conditions and some perceptible improvement in inquiries are stimulating a more hopeful spirit in the trade. The reduction in output has had not the slightest effect. Two or three large interests recently put forth an effort to make conditional sales for summer delivery. The attempt failed. No argument to buy more for future needs carries any weight. Some small lots of forge and foundry have been taken and there are a few scattered buyers coming along all the time.

Pittsburg

May 12—There is an improvement in iron and steel conditions, but indications are that it will be only temporary. The Carnegie Steel Company yesterday started two mills in Pittsburg, both of which had been idle for three weeks. It also added some mills at the Homestead works to the active list. The Edgar Thomson rail plant is running less than one-half capacity. The Carter Iron and Steel Company started its big works near Homestead yesterday. The Singer plant of the Crucible Steel Company is going again. The bessemer steel plant of the Republic company is down this week, but the Valley and Brown-Bonnell works in the Youngstown district are going.

The bi-monthly settlements of wages under the sliding scale of the Amalgamated Association occurred yesterday and today. The sales sheets of the Republic company showed the average price of common iron bars for March and April to have been 1.45c., the same as the previous settlement. This indicates that 1.55c. Pittsburg for bar iron is being firmly maintained. The average of tinplate sales was under $3.50 a box, which puts wages down to the base, making a cut of 2 per cent. The decline in tinplate prices was due to heavy shipments made by the American Sheet and Tin Plate Company to Canada in order to avoid the duty which became effective on May 1. There was no change in the sheet average, sales remaining at the base of 2.30c. below which wages cannot drop.

The second week of the convention at Youngstown, O., of the Amalgamated Association of Iron, Steel and Tin Workers opened today. It is believed that no changes in the present scales will be asked. The companies that have been recognizing the association will likely insist upon some modifications. It is also reported that some large interests will refuse to recognize the organization after June 30.

Pig Iron—Sales are confined to small lots and carloads. Prices remain about the same as last week, except basic which has declined from $15.50 to $15. Other grades are quoted as follows: Bessemer, $16; No. 2 foundry, $14.50; gray forge, $14; malleable bessemer, $15, all f.o.b. Valley furnaces.

Steel—Bessemer and open-hearth billets are still $28, Pittsburg, the seller dividing the freight. Tank plates are firm at 1.70c., but it is reported that some interests are shading the 1.60c. rate on merchant steel bars.

Sheets—There is a fairly good demand. Black sheets are quoted at 2.50c., and galvanized at 3.55c. for No. 28 gage.

Ferro-Manganese—Prices are $45@45.50, an advance of $1 a ton.

Metal Market

Gold and Silver Exports and Imports

NEW YORK, May. 13.
At all U. S. Ports in March and year.

Metal.	Exports.	Imports.	Excess.
Gold:			
Mar. 1908..	$ 1,447,206	$ 3,618,885	Imp. $2,171,679
" 1907..	2,126,173	5,046,243	" 2,920,070
Year 1908..	3,859,003	17,398,551	" 13,539,548
" 1907..	5,703,304	11,646,615	" 5,943,317
Silver:			
Mar. 1908..	4,329,369	3,723,307	Exp. $606,062
" 1907..	5,058,461	4,006,497	" 1,051,964
Year 1908..	12,586,257	10,796,986	" 1,791,971
" 1907..	14,669,396	11,385,526	" 3,283,870

Exports from the port of New York, week ended May 2: Gold, $11,000, to Haiti; silver, $787,600, chiefly to London. Imports: Gold, $147,650, from Central and South America; silver, $39,327, from the West Indies.

Specie holdings of the leading banks of the world May 9 are reported, as below, in dollars:

	Gold.	Silver.	Total.
Ass'd New York	.....	.....	$313,304,500
England	$187,346,935	.....	187,346,935
France	581,584,065	$181,598,590	763,182,655
Germany	162,090,000	67,175,000	229,265,000
Spain	77,755,000	131,995,000	209,750,000
Netherlands	38,490,000	21,629,500	60,119,500
Belgium	20,356,665	10,178,335	30,535,000
Italy	181,680,000	22,000,000	203,680,000
Russia	560,115,000	33,780,000	593,895,000
Aust.-Hungary	232,870,000	67,575,000	300,445,000
Sweden	19,475,000	.....	19,475,000
Norway	7,680,000	.....	7,680,000
Switzerland	16,870,000	.....	16,870,000

The New York banks do not separate gold and silver. The foreign statements are from the *Commercial and Financial Chronicle* of New York.

Silver Market

SILVER AND STERLING EXCHANGE.

May.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.	May.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.
7	4.8705	52⅜	24 3/16	11	4.8725	52½	24 3/16
8	4.8710	52⅜	24⅛	12	4.8725	52¼	24 1/16
9	4.8725	52¼	24 1/16	13	4.8715	52⅜	24⅛

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Messrs. Pixley & Abell report silver shipments from London to the East for the year to April 30:

	1907.	1908.	Changes.
India	£4,465,334	£2,537,438	D. £1,927,896
China	.....	511,400	I. 511,400
Straits	321,500	90,200	D. 231,300
Total	£4,786,834	£3,139,038	D. £1,647,796

Imports for the week were £193,000 from New York. Exports were £5000 to Hong Kong and £227,000 to India; £232,000 in all.

Silver has remained fairly steady the past week, closing at 24⅛d. in London. The market has been limited, with small buyers and sellers. The Indian bazaars still continue to be the principal consumers. Their demand, however, is small for the present. The United States Mint is not buying just now.

Copper, Tin, Lead and Zinc

May.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. Cts. per lb.	Spelter. New York, Cts. per lb.	Spelter. St. Louis, Cts. per lb.
7	12⅝ @13¾	12 3/8 @12⅝	56⅞	31	4.20 @4.22½	4.62½ @4.65	4.47½ @4.50
8	12⅝ @12¾	12 3/8 @12⅝	56¾	30¼	4.22½ @4.25	4.62½ @4.65	4.47½ @4.50
9	12⅝ @12¾	12 3/8 @12⅝	.....	30¼	4.22½ @4.27½	4.62½ @4.65	4.47½ @4.50
11	12⅝ @12¾	12 3/8 @12⅝	57⅛	30¾	4.22½ @4.27½	4.62½ @4.65	4.47½ @4.50
12	12⅝ @12¾	12 3/8 @12⅝	56¾	30¼	4.22½ @4.27½	4.62½ @4.65	4.47½ @4.50
13	12⅝ @12¾	12 3/8 @12⅝	57⅛	29	4.22½ @4.27½	4.62½ @4.65	4.47½ @4.50

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electrolytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—The reports from abroad at the beginning of the week were decidedly discouraging. The crisis in Japan has forced large quantities of copper on the market which had been held for higher prices, and the offerings from that source had a depressing effect upon all markets. The domestic business is still of a desultory character, but the feeling is hopeful that the long-looked-for improvement is very near realization. Quotations at the close are 12⅝@12¾c. for Lake copper; 12⅜@12⅝c. for electrolytic in ingots, cakes and wirebars. The average of the week for casting is 12¼@12½ cents.

The speculative market in London has been depressed throughout the week, but the closing cables indicate a steadier tone, spot being quoted at £57 2s. 6d.; three months, £57 17s. 6d.

Refined and manufactured sorts we quote: English tough, £61@62; best selected, £61@62; strong sheets, £73@74.

Exports of copper from New York and Philadelphia for the week were 1766 tons. Exports from Baltimore for the week are reported by our special correspondent at 230 long tons of copper.

Manufactured Copper — Sheets, cold-rolled, 18c.; hot-rolled, 17c. Wire, 14¾c. base.

Tin—The London bear party operating in this metal seemingly had it all its own way during the past week. They were supported by an utter absence of demand from this side, where consumers are holding back. London closes weak at £132 10s. for spot, £132 for three months, while quotations here are about 29c. for prompt material.

Lead—A good business has again been done, and as a result of it, prices have advanced further, the close being steady at 4.22½@4.27½c. New York.

The situation in the London market is unchanged, the close being £12 17s. 6d. for Spanish lead, £13 for English.

The John Wahl Commission Company telegraphs us from St. Louis, May 11, that lead is firm but quiet. Latest sales are on the basis of 4.12½c. for Missouri brands.

Spelter—The market is very lifeless, and quotations are unchanged at 4.62½@4.65c. New York, 4.47½@4.50c. St. Louis.

The London market has suffered a severe break, the closing being cabled at £19 17s. 6d. for good ordinaries, £20 2s. 6d. for specials.

The Government has decided to appeal from Judge Burns' decision in the zinc-ore case, taking the appeal to the United States Circuit Court of Appeals for the fifth circuit. The Circuit Court of Appeals does not sit until October next.

Zinc Sheets—Base price is 7c. f.o.b. Lasalle-Peru, less 8 per cent.

Other Metals

Antimony—The market is quiet and steady and little business is being done There seems to be no disposition to sell either in New York or abroad. Quotations are 8¾@9c. for Cookson's, 8½@8¾c. for Hallett's and 8⅛@8¼c. for ordinary brands.

Aluminum—Ingots, American No. 1, in large quantities, 33c. per lb. Rods and wire, 38c. base; sheets, 40c. base.

Cadmium—In 100-lb. lots, $1.25 per lb., Cleveland, Ohio.

Nickel—According to size of lot and terms of sale, 45@50c., New York.

Quicksilver—New York, $45 per flask. San Francisco, large lots nominal at $44.50, domestic, and $43, export; small orders, $45@46. London, £8 5s.

Platinum—A reduction of 50c. per ounce brought prices to $25.50 for hard platinum, $23 for ordinary, and $16 for scrap.

Missouri Ore Market

Joplin, Mo., May 9—The highest price paid for zinc was $39, on an assay base price ranging from $36.50 down to $34 per ton of 60 per cent. zinc, all grades averaging $33.74. The highest price for lead was $56.50, with medium grades commanding $54 to $56, and all grades averaging $53.84 per ton. The average price of both ores was lessened by the increased shipment of the carbonate and silicate grades.

The shallower mines are practically all unwatered from the heavy April rains, but the sheet-vein mines are contending with a heavier pumping proposition; still the output is gradually increasing.

Following are the shipments from the various camps of the district for the week ending May 9:

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	3,243,710	794,680	$78,220
Joplin	1,514,370	343,730	35,954
Galena	813,630	105,410	16,631
Prosperity	533,080	53,580	10,774
Duenweg	512,920	39,450	10,041
Oronogo	499,920	.....	8,737
Badger	387,390	4,900	6,916
Granby	492,820	14,360	6,730
Seneca	36,600	152,740	3,848
Quapaw-Baxter	215,890	.....	3,670
Aurora	247,990	6,990	3,447
Carthage	176,340	.....	3,174
Alba-Neck	145,650	.....	2,621
Spurgeon	139,980	22,220	2,161
Sarcoxie	80,750	.....	1,372
Zincite	61,350	.....	1,072
Miami	63,730	.....	828
Peoria	32,470	.....	162
Totals	9,198,590	1,538,060	$196,358
19 weeks	173,098,210	24,954,550	$3,623,030
Zinc value, the week, $155,178; 19 weeks,			$2,995,101
Lead value, the week, 41,180; 19 weeks,			627,929

Average ore prices in the Joplin market were, by months:

ZINC ORE AT JOPLIN.			LEAD ORE AT JOPLIN.		
Month.	1907.	1908.	Month.	1907.	1908.
January	45.84	35.56	January	83.58	46.88
February	47.11	34.92	February	84.58	49.72
March	48.66	34.19	March	82.75	49.90
April	48.24	34.08	April	79.76	52.47
May	45.98	.....	May	79.56	.....
June	44.82	.....	June	73.66	.....
July	45.79	.....	July	68.18	.....
August	43.22	.....	August	59.54	.....
September.	40.11	.....	September.	53.52	.....
October	39.83	.....	October	51.40	.....
November.	35.19	.....	November.	43.40	.....
December.	30.87	.....	December.	37.71	.....
Year	43.68	.....	Year	68.90	.....

Wisconsin Ore Market

Platteville, Wis., May 9—The highest price paid for zinc ore this week was $38, on a basis of $36@37 per ton of 60 per cent. zinc. Lead ore sold at $53 per ton of 80 per cent. lead.

In addition to the above there was shipped to the Joplin Separator Works at Galena, from Rewey, 114,000 lb. and from Benton, 64,700; and to the electrostatic separator at Platteville, from Benton, 170,000 lb. zinc ore.

Ore shipments, week ended May 9, were:

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Platteville	652,850	.....	.....
Benton	217,630	150,600	.....
Galena	188,000	.....	.....
Days Siding	160,000	.....	.....
Dubuque	160,000	.....	.....
Elmo	131,060	.....	.....
Livingston	100,000	.....	.....
Linden	98,310	.....	.....
Mineral Point	80,000	.....	.....
Hazel Green	75,500	.....	.....
Total	1,863,350	150,600	.....
Year to May 9	25,308,440	2,228,945	79,800

Chemicals

New York, May 13—The absence of demand continues and purchasers continue the hand-to-mouth policy. Trade all over the country is light, especially in New England, where the textile and paper industries are practically out of the market.

Copper Sulphate—The demand is neither heavy nor light. Prices remain the same as last week at $4.65 per 100 lb. for carloads, and $4.90 for single barrel lots.

Nitrate of Soda—The market holds firm, but business is not particularly heavy. Quotations remain unchanged at 2.32½c. for spot and 2.30c. for other positions of 1908. Deliveries in 1909 fetch 2.30c., and for 1910 the price is nominally 2.32½c. Spot 96-per cent. grade sells for 2.37½c.

Phosphate Rock—Shipments of phosphate rock through the port of Charleston, S. C., were reported, by P. C. Trenholm, to be 5322 tons in April. All shipments were by rail.

J. M. Lang & Co., Savannah, Ga., report shipments of phosphate rock through that port at 11,178 tons. Of this 4593 tons went to Holland, 4072 tons to Germany, and 2513 tons to England.

Mining Stocks

New York, May 13—Business has been active, and prices fairly strong on the stock exchange. It has, however, been a professional market mainly, and the public is not buying on any considerable scale. There are reports of further gold exports, but this has not affected stocks. The banks have a very large surplus, which will not be seriously affected by withdrawals for foreign account.

The curb market followed the Exchange, with prices rather strong and a good deal of trading, but not much outside buying. The copper stocks have been rather more in demand than for some weeks past.

Boston

May 12—Mining-share prices are at about the best of the year, thanks to growing confidence. Of course the manifest strength of Amalgamated has had a lot to do with speculative sentiment. This stock reached $65.12½ today, which is an advance of $3.75 for the week. The Quincy Mining Company announces another reduction in its quarterly dividend

to $1. This had no effect; in fact the stock actually advanced in face of it, going to $83.

Atlantic has had a fluctuating week. After declining $1.25 to $12.50 on profit-taking, it rose to $15.50 and closes at $15. Although the Baltic lode has not yet been tapped in section 6, a good grade of copper rock has been encountered. Copper Range rose $2 to $72. Boston & Corbin has been an active feature since President Amster's return from the property. The price has risen $3.50 to $15.50 on active trading.

On the curb Nevada-Utah had an active time, and stiffened to $4.50. Current reports are that T. W. Lawson is no factor in this stock now.

STOCK QUOTATIONS

NEW YORK	May 12
Name of Comp.	Clg.
Alaska Mine	1/8
Amalgamated	64 3/8
Anaconda	39 7/8
Balaklala	‡2 3/8
British Col. Cop.	5
Butte & London	1/4
Butte Coalition	23 3/8
Colonial Silver	1/4
Cum. Ely Mining	8 1/8
Davis Daly	3 1/4
Dominion Cop.	1 1/8
Douglas Copper	5
El Rayo	1 5/8
Florence	3 3/8
Foster Cobalt	.72
Furnace Creek	.15
Giroux	3 1/2
Gold Hill	3/8
Goldfield Con.	5 7/8
Granby	‡90 1/4
Greene Gold	1 1/8
Greene G. & S	3/8
Greenw'r & D.Val.	.75
Guanajuato	2 1/4
Gnggen. Exp.	160
Hanapah	‡.20
McKinley Dar.	.78
Micmac	4
Mines Co. of Am.	1 1/8
Mitchell Mining	5/8
Mont. Sho.C	1 1/16
Nev. Utah M. & S.	4 5/16
Newhouse M. & S.	7 1/8
Nipissing Mines	6 7/8
Old Hundred	7/8
Silver Queen	1.10
Stewart	1/16
Tennessee Cop'r	37 7/8
Tri-Bullion	1 7/8
Union Copper New	1
Utah Apex	3
Utah Copper	30
Yukon Gold	4 1/4

N. Y. INDUSTRIAL	
Am. Agri. Chem.	20
Am. Smelt. & Ref.	75
Am. Sm. & Ref., pf.	100
Bethlehem Steel	‡15
Colo. Fuel & Iron	27 3/4
Federal M. & S., pf.	74 1/2
Inter. Salt	17 1/2
National Lead	63 1/4
National Lead, pf.	‡99 3/4
Pittsburg Coal	12 1/4
Republic I. & S.	18 1/4
Republic I. & S., pf.	68 1/2
Sloss-Sheffield	47
Standard Oil	600
U. S. Red. & Ref.	8 1/4
U. S. Steel	36 7/8
U. S. Steel, pf	101 3/8
Va. Car. Chem.	23
Va. I. Coal & Coke	52 1/2

ST. LOUIS	May 9	
N. of Com.	High.	Low.
Adams	.30	.20
Am. Nettle	.03	.02
Center Cr'k	2.00	1.50
Cent. C. & C.	67.00	65.00
C.C. & C. pd.	76.00	75.00
Cent. Oil	100.00	95.00
Columbia	4.50	3.00
Con. Coal	19.00	16.00
Doe Run	125.00	110.00
Gra. Bimet.	.20	.15
St. Joe.	15.00	12.50

BOSTON	May 12
Name of Comp.	Clg.
Adventure	2
Allouez	27 3/4
Am. Zinc	‡23 1/4
Arcadian	3 1/2
Arizona Com	18
Atlantic	15
Bingham	‡.25
Boston Con	12 1/4
Calumet & Ariz*	107
Calumet & Hecla	655
Centennial	23 1/2
Con. Mercur	‡.39
Copper Range	71 1/8
Daly-West	9 1/2
Franklin	7 3/4
Greene—Can	9
Isle Royal	20 1/2
La Salle	14 3/4
Mass	‡2 3/4
Michigan	10 1/8
Mohawk	50
Nevada	11 5/8
North Butte	61 1/4
Old Colony	‡.50
Old Dominion	37
Osceola	87 1/2
Parrot	22
Quincy	82 1/2
Rhode Island	‡2 3/4
Santa Fe	‡1 3/4
Shannon	12 3/4
Superior	18 1/2
Tamarack	59
Trinity	14
United Cop., com.	‡6
U. S. Oil	23
U. S. Smg. & Ref.	38
U.S.Sm. & Re.,pd.	44
Utah Con	41
Victoria	3
Winona	5 1/2
Wolverine	134
Wyandotte	‡.50

*Ex. Div. †Ex. Rights. ‡Last quotation.

BOSTON CURB	
Ahmeek	70
Black Mt.	‡4 3/4
East Butte	5 1/4
Hancock Con.	4
Keweenaw	5 7/8
Majestic	.83
Raven	1 7/16
Shawmut	.33
Superior & Pitts.	12 3/4
Troy Man	.50

LONDON	May 13		
Name of Com.	Clg.		
Dolores	£1	5s	0d
Stratton'sInd.	0	1	6
Camp Bird	0	13	9
Esperanza	1	7	6
Tomboy	1	11	3
El Oro	1	3	1 1/2
Oroville	0	11	6
Somera	.	.	.
Utah Apex	.	.	.
Ariz. Cop.,pfd.	.	.	.
Ariz. Cop.,def.	.	.	.

Cabled through Wm. P. Bonbright & Co., N.Y.

NEVADA STOCKS. May 13.
Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.	Name of Comp.	Clg.
COMSTOCK STOCKS		Silver Pick	.20
Belcher	.25	St. Ives	.33
Best & Belcher	.57	Triangle	.07
Caledonia	.16	BULLFROG STOCKS	
Challar	.10	Bullfrog Mining	.05
Comstock	.40	Bullfrog Nat. B.	.06
Con. Cal. & Va.	.39	Gibraltar	.06
Crown Point	.32	Gold Bar	.10
Exchequer	.21	Homestake King	.29
Gould & Curry	.10	Montgomery Mt.	.07
Hale & Norcross	.34	Mont. Shoshone C.	.87 1/2
Mexican	1.37	Original Bullfrog	.02
Ophir	2.77 1/2	Tramp Cons	.18 1/2
Overman	.10	MANHAT'N STOCKS	
Potosi	.14	Manhattan Cons.	.12
Savage	.28	Manhat'n Dexter	.05
Sierra Nevada	.35	Jumping Jack	.04
Union	.33	Stray Dog	.05
Utah	.03	MISCELLANEOUS	
Yellow Jacket	.75	Golden Boulder	.07
TONOPAH STOCKS		Bonnie Clare	.10
Belmont	1.00	Lee Gold Grotto	
Extension	.81 1/2	Nevada Hills	2.12 1/2
Golden Anchor	.02	Nevada Smelting	1.25
Jim Butler	.28	Pittsburgh S. Pk.	1.23
MacNamara	.27	Round Mt. Sphinx	.26
Midway	.43		
Montana	1.57		
North Star	.12		
Tono'h Mine of N.	7.87 1/2		
West End Con	.37		
GOLDFI'D STOCKS			
Adams	.05		
Atlanta	.23		
Booth	.19		
Columbia Mt.	.18		
Comb. Frac	.63		
Cracker Jack	.07		
Dia'dfield B. B. C.	.18 1/2		
Goldfield Belmont	.15		
Goldfield Daisy	1.23		
Great Bend	.33		
Jumbo Extension	.31		
Katherine			
Kendall	.19		
Lone Star	.08		
May Queen	.06		
Oro	.09		
Red Hill	.24		
Roanoke			
Sandstorm	.32		

COLO. SPRINGS	May 9
Name of Comp.	Clg.
Acacia	5 3/4
Black Bell	
C. C. Con	3 1/2
Dante	8 1/2
Doctor Jack Pot	7 1/4
Elkton	56 3/4
El Paso	39
Findlay	25
Gold Dollar	‡6
Gold Sovereign	‡3 5/8
Isabella	35 1/2
Index	
Jennie Sample	4 3/4
Jerry Johnson	
Mary McKinney	
Pharmacist	3 1/2
Portland	1.00
Un. Gold Mines	‡4 1/2
Vindicator	
Work	10 1/2

New Dividends

Company.	Payable.	Rate.	Amt.
Alaska Mexican	Apr. 28	$0.50	$ 90,000
Alaska Treadwell	Apr. 28	0.75	150,000
Amalgamated	May 25	0.50	765,439
Bunker Hill & Sullivan	May 4	0.25	75,000
Calumet & Arizona	Apr. 25	1.00	200,000
Consolidation Coal	Apr. 30	1.50	153,750
Elkton	Apr. 24	0.01 1/2	37,500
Esperanza	Apr. 18	1.09	495,950
Hecla	Apr. 20	0.01	10,000
Homestake	Apr. 25	0.50	109,200
Inter. Nickel, pfd.	May 1	1.50	131,123
Jamison	Apr. 18	0.02	7,800
Kerr Lake	Apr. 15	0.15	90,000
Lehigh Coal & Nav.	May 27	2.00	639,802
Nipissing	Apr. 20	0.15	180,000
N. Y. & Hond. Rosario	Apr. 25	0.10	15,000
Penn. Salt Mfg.	Apr. 15	3.00	180,000
Portland	Apr. 15	0.04	120,000
Silver Queen	May 15	0.05	75,000
United States, com.	Apr. 15	0.50	175,466
United States, pfd.	Apr. 15	0.87 1/2	425,114
U. S. Steel, com.	June 30	0.50	2,541,513
U. S. Steel, pfd.	June 1	1.75	6,305,497
Utah Con	Apr. 15	0.50	150,000
Va. Car. Chem., pfd.	Apr. 15	2.00	360,000
Vindicator	Apr. 25	0.04	60,000

Assessments

Company.	Delinq.	Sale.	Amt.
Andes, Nev.	Apr. 23	May 15	$0.10
Belcher, Nev.	Apr. 29	May 20	0.10
Big Creek, Ida.	Apr. 17	May 16	0.01
Brunswick Con., Cal.	May 27	June 26	0.03
Butler-Liberal, Utah	Apr. 25	May 13	0.02
Century, Utah	Apr. 14	May 14	0.02
Charm, Utah	Apr. 31	May 13	0.01
Federal	Apr. 25	May 18	0.05
Jenny Lind, Cal.	May 11	May 28	0.05
New Red Wing, Utah	May 2	May 19	0.01
Old Evergreen	Apr. 14	May 14	0.01
Oro Cebre, Cal.	Apr. 17	May 16	0.02
Posey Canyon, Cal.	Apr. 28	May 16	0.02
Potosi, Nev.	Apr. 20	May 3	0.10
Quincy, Jr., Utah	Mar. 21	Apr. 20	0.02
Silver Bell, Utah	Apr. 10	Apr. 27	0.01
Wabash, Utah	May 9	June 1	0.10
Washakie-Nev., Nev.	Apr. 20	May 7	0.15
Western Mines, Nev.	Mar. 16	Apr. 23	0.01 1/2
Zeibright, Cal.	May 12	June 1	0.05

Monthly Average Prices of Metals

AVERAGE PRICE OF SILVER

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	68.673	55.678	31.769	25.738
February	68.835	56.000	31.852	25.855
March	67.519	55.365	31.325	25.570
April	65.462	54.505	30.253	25.133
May	65.981		30.471	
June	67.090		30.893	
July	68.144		31.366	
August	68.745		31.637	
September	67.792		31.313	
October	62.435		28.863	
November	58.677		27.154	
December	54.565		25.362	
Year	65.327		30.188	

New York, cents per fine ounce; London, pence per standard ounce.

AVERAGE PRICES OF COPPER

	NEW YORK. Electrolytic		NEW YORK. Lake.		LONDON.	
	1907.	1908.	1907.	1908.	1907.	1908.
January	24.404	13.726	24.825	13.901	106.739	62.386
February	24.869	12.905	25.236	13.098	107.356	58.786
March	25.065	12.704	25.560	12.875	106.594	58.761
April	24.224	12.743	25.260	12.928	98.625	58.331
May	24.048		25.072		102.375	
June	22.665		24.140		97.272	
July	21.130		21.923		95.016	
August	18.356		19.255		79.679	
September	15.565		16.047		68.375	
October	13.169		13.551		60.717	
November	13.391		13.870		61.226	
December	13.163		13.393		60.113	
Year	20.004		20.661		87.007	

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

AVERAGE PRICE OF TIN AT NEW YORK

Month.	1907.	1908.	Month.	1907.	1908.
January	41.548	27.380	July	41.091	
February	42.102	28.978	August	37.667	
March	41.313	30.577	September	36.689	
April	40.938	31.702	October	32.620	
May	43.149		November	30.833	
June	42.120		December	27.925	
			Av. year	38.166	

Prices are in cents per pound.

AVERAGE PRICE OF LEAD

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	6.000	3.691	19.828	14.469
February	6.000	3.725	19.531	14.250
March	6.000	3.838	19.703	13.975
April	6.000	3.993	19.975	13.469
May	6.000		19.688	
June	5.760		20.188	
July	5.288		20.350	
August	5.250		19.063	
September	4.813		19.775	
October	4.750		18.531	
November	4.376		17.281	
December	3.658		14.500	
Year	5.325		19.034	

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

AVERAGE PRICE OF SPELTER

MONTH.	New York.		St. Louis.		London.	
	1907.	1908.	1907.	1908.	1907.	1908.
January	6.732	4.513	6.582	4.363	27.125	20.563
February	6.814	4.788	6.664	4.638	25.938	20.875
March	6.837	4.665	6.687	4.527	26.094	21.075
April	6.685	4.645	6.535	4.495	25.900	21.344
May	6.441		6.291		25.563	
June	6.419		6.269		25.469	
July	6.072		5.922		23.850	
August	5.701		5.551		21.969	
September	5.236		5.086		21.050	
October	5.430		5.280		21.781	
November	4.925		4.775		21.438	
December	4.254		4.104		20.075	
Year	5.962		5.812		23.771	

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

Metal and Mining Companies—U. S.

Name of Company and Location.		Author-ized Capital	Shares. Issued.	Par Val.	Dividends. Total to Date.	Latest. Date.	Amt.
Alaska Mexican, g.	Al'ka	$1,000,000	180,000	$ 5	$1,896,381	Apr. 1908	$ .50
Alaska Treadwell,g.	Al'ka	5,000,000	200,000	25	9,935,000	Apr. 1908	.75
Alaska United, g.	Al'ka	1,000,000	180,200	5	333,370	Jan. 1908	.15
Amalgamated, c.	Mont	155,000,000	1,530,879	100	56,718,304	May 1908	.50
Am.Sm.&Ref.,com.	U. S.	50,000,000	500,000	100	13,125,000	Apr. 1908	1.00
Am. Sm. & Ref. pf.	U. S	50,000,000	500,000	100	27,088,053	Apr. 1908	1.75
Am. Smelters, pf. A	U. S.	17,000,000	170,000	100	2,450,000	Mar. 1908	1.50
Am. Smelters. pf. B	U. S.	30,000,000	300.000	100	4,125,000	Mar. 1908	1.25
Am.Zinc,Lead&Sm.	Kan.	3,750,000	80,000	25	280,000	Nov. 1907	.50
Anaconda,c.	Mont	30,000,000	1,200,000	25	39,650,000	Apr. 1908	.50
Arizona, c.	Ariz	3,775,000	3,682,520	.....	6,182,361	Apr. 1906	.05
Atlantic, c	Mich	2,500,000	100,000	25	990,000	Feb. 1905	.02
Bald Butte, g. s.	Mont	250,000	250,000	1	1,354,648	Oct. 1907	.04
Beck Tunnel, g.s.l.	Utah	100,000	1,000,000	0.10	675,000	Oct. 1907	.02
Bingham & N.H.,c.g	Utah	2,000,000	226,000	5	22,600	Sept. 1906	.10
Boston & Montana.	Mont	3,750,000	150,000	25	49,675,000	Apr. 1908	3.00
Bull.Beck.&Cham.g	Utah	1,000,000	100,000	10	2,688,400	Apr. 1907	.10
Bunker Hill & Sull.	Ida	3,000,000	300,000	10	10,146,000	May 1908	.25
Butte Coalition,c.s.	Mont	15,000,000	1,000,000	15	2.450,000	Dec. 1907	.15
Calumet & Arizonac	Ariz	2,500,000	200,000	10	9,500.000	Apr. 1908	1.00
Calumet & Hecla,c.	Mich	2,500,000	100,000	25	106.350,000	Mar. 1908	5.00
Camp Bird, g., s.	Colo	5,500,000	820,000	5	5,229,673	Mar. 1908	.48
Carisa, c.g.	Utah	500,000	500,000	1	55,000	Nov. 1906	.01
Colorado, l. g. s.	Utah	200,000	1,000,000	0.20	670,000	Jan. 1908	.05
Columbus Con. c.	Utah	1,500,000	283,540	5	226,832	Oct. 1907	.20
Combi'tion Co.G'f'd	Nevada	400,000	320,000	1	688,000	Sept. 1906	.15
Con. Mercur, g.	Utah	1,000,000	1,000,000	1	3,385,313	Dec. 1906	.02½
Continental, z. l.	Mo.	550,000	22,000	25	220,000	Oct. 1907	.50
Copper Range Con.	Mich	38,500,000	383,781	100	6,861,582	Apr. 1908	1.00
Creede United, g.	Colo.	2,000,000	1,625,000	1	214 053	July 1906	.00½
Daly Judge, g. s. l.	Utah	300,000	300,000	1	225,000	Apr. 1907	.37½
Daly West, g. s. l.	Utah	3,600,000	180,000	20	5,877,000	Dec. 1907	.30
De Lamar, g. s.	Ida	400,000	67,180	5	2,926,370	May 1905	.72
Dillon, g.	Colo.	1,250,000	1,250,000	1	21,875	July 1905	.01
Doctor Jack Pot.	Colo.	3,000,000	3,000,000	1	277,000	June 1906	.00½
Doe Run, l.	Mo.	10,000,000	59,062	100	1,523,631	Mar. 1908	.50
Elkton Con., g.	Colo.	3,000,000	2,500,000	1	2,079,461	Apr. 1908	.01½
El Paso, g.	Colo.	2,500,000	2,450,000	1	1,022,750	June 1906	.01
Fed. Sm., com.	Idaho	10,000,000	60.000	100	2,708,750	Mar. 1908	1.50
Federal Sm., pf.	Idaho	20,000,000	120,000	100	3,491,250	Mar. 1908	1.75
Findley, g.	Colo.	1,250,000	1,250,000	1	337,500	Sept. 1906	.01
Florence, g.	Nevada	1,250,000	1,050,000	1	210,000	Apr. 1908	.10
Frances-Mohawk,g	Nevada	1,000,000	910,000	1	410,000	Jan. 1908	.05
Gemini-Keystone	Utah	500,000	5,000	100	1,950,000	July 1907	10.00
Gold King Con	Colo.	5,750,370	5,750,370	1	1,407,504	May 1905	.01
Goldfield Con., g.	Nevada	50,000,000	5,000,000	10	1,000,000	Nov. 1907	.10
Grand Central, g.	Utah	250,000	250,000	1	1,333,000	Oct. 1907	.05
Gwin Mine, Dev., g.	Cal	1,000,000	100,000	10	496,000	Apr. 1906	.05
Hecla, s. l.	Idaho	250.000	1,000,000	0.25	1,560,000	Apr. 1908	.01
Homestake, g.	S. D.	22,000,000	218.400	100	22,640,840	Apr. 1908	.50
HornSilver,g.s.c.z.l	Utah	10,000,000	400,000	25	5,642,000	Sept. 1907	.05
Inter'l Nickel, pf.	N. Y.	12,000,000	89,126	100	1,336,890	May 1908	1.50
Iron Silver	Colo.	10,000,000	500,000	20	4,100,000	Oct. 1907	.10
Jamison, g.	Cal	3,900 000	390,000	10	301,870	Apr. 1908	.02
Jerry Johnson.	Cal	2,500,000	2,500,000	1	86,700	Jan. 1908	.01
Kendall, g.	Mont	2,500,000	500 000	5	1,205,000	Feb. 1908	.02
Liberty Bell,g. s.	Colo.	700,000	130,551	5	130,440	Jan. 1907	.15
Lightner, g.	Cal	125,000	102,255	1	253,081	Oct. 1906	.05
Lower Mammoth, g	Utah	190,000	190,000	1	42,750	Aug. 1907	.07½
Mammoth, g. s. l.	Utah	10,000 000	400,000	2.50	2,220,000	Mar. 1908	.05
Mary McKinney, g.	Colo.	1,500,000	1,304,252	1	801.765	Apr. 1907	.03
May Day, g. s. l.	Utah	800,000	800,000	1	70,010	Oct. 1907	.01½
Mohawk, c.	Mich	2,500,000	100,000	25	1,400,000	July 1907	5.00
Mont. Ore Purch.	Mont	2,500,000	80,833	25	9.437.274	Jan. 1907	15.00
Nevada Hills, s.g.	Nevada	5,000,000	746,000	5	373,000	Dec. 1907	.10
New Century, z., l.	Mo.	300,000	300,000	1	230,300	Aug. 1907	.00½
Newhouse M. & S.c.	Utah	6,000,000	600,000	10	300,000	Sept. 1907	.50
New Idria, q	Cal	500.000	100,000	5	990,000	Apr. 1908	.30
New Jersey Zinc	U. S.	10,000,000	100,000	100	8,400,000	Feb. 1906	3.00
North Butte	Mont	6,000,000	400,000	15	5,200,000	Sept. 1907	2.00
North Star, g	Cal	2,500,000	250,000	10	1,599,489	Mar. 1908	.25
Old Dominion, c.	Ariz	8,750,000	293,245	25	574,088	Aug. 1907	1.00
OldDominion,M&Sc	Ariz	5,000,000	162,000	25	202,500	Aug. 1907	1.25
Old Gold	Colo.	2,101,150	2,101,150	1	10,506	Mar. 1906	.05
Ophir, g. s	Nevada	302,400	100,800	3	1,796,200	July 1904	.25
Osceola, c	Mich	2,500,000	96,150	25	7,035.650	July 1907	7.00
Parrot, c,s.	Mont	2,300,000	229,850	10	6,807,649	Sept. 1907	.25
Pennsylvania, g.	Cal	5,150,000	51,500	100	284,925	July 1905	.10
Pitts. L. & Z., l.z.	Mo	1,000,000	1,000,000	1	20,000	July 1907	.02
Portland, g.	Colo.	3,000,000	3,000,000	1	7,876,080	Apr. 1908	.04
Quartette, g. s.	Nevada	1,000,000	100,000	10	375,000	July 1907	.20
Quincy, c	Mich	3,750,000	110,000	25	18,120,000	Mar. 1908	1.50
Rocco Homest'k,l.s.	Nevada	300,000	300,000	1	112.000	Dec. 1905	.02
Sacramento, g, q.	Utah	1,000,000	1,000,000	1	258,000	Nov. 1906	.00½
St. Joseph, l.	Mo.	20,000,000	1,000,000	10	5,708,357	Mar. 1908	.15
Silver Hill, g. s	Nevada	108,000	108.000	1	81 000	June 1907	.05
Silver King, g. s. l †	Utah	3.000,000	150,000	20	11,187,500	July 1907	.33½
Silver King Co't'n.†	Utah	6,250,000	1,250,000	5	375,000	Oct. 1907	.15
Shannon, c.	Ariz.	3,000,000	300,000	10	450.000	July 1907	.50
Snowstorm, s. l.	Ida	1,500,000	1,500,000	1	450,000	Sept. 1907	.03
Standard Con., g. s.	Cal	2,000,000	178,394	10	5,158,452	Dec. 1907	.10
Stratton'sIndepend	Colo.	5,500,000	1,000,007	5	4.895,865	Apr. 1906	.12½
Swansea, g. s. l.	Utah	500,000	100,000	5	329,500	Mar. 1907	.05
Tamarack, c	Mich	1,500,000	60,000	25	9,420,000	July 1907	4.00
Tennessee, c.	Tenn	5,000,000	200,000	25	1,806,250	Feb. 1908	1.25
Tomboy, g. s.	Colo.	1,750,000	300,000	5	900.000	June 1906	.48
Tonopah of Nev.	Nevada	1,000,000	1,000,000	1	3,500,000	Oct. 1907	.25
Tonopah Belmont.	Nevada	2,000,000	1,295,007	1	518,003	Apr. 1907	.10
Tonopah Ext'nsion	Nevada	1,000,000	928,433	1	283,030	Apr. 1906	.15
Tonopah Midway.	Nevada	1,000,000	1,000,000	1	250,000	Jan. 1907	.05
Uncle Sam, g.s.l.	Utah	500,000	500,000	1	200.000	Dec 1907	.03
United States, com.	Utah	37,500,000	350,933	50	1,271,698	Apr. 1908	.50
United States, pfd.*	Utah	37,500,000	485,845	50	3,606,043	Apr. 1908	.87½
United Cop. com.	Mont	75,000,000	450,000	100	5,962,500	Aug. 1907	1.75
United, c. pf.	Mont	5.000,000	50,000	100	1.500,000	May 1907	3.00
United, z. l., pf.	Mo.-Kan.	500,000	19,556	25	303,006	Oct. 1907	.50
United Verde, c.	Ariz.	3,000,000	300,000	10	19.935.322	Mar. 1908	.75
U.S. Red. & Ref. Pf	Colo.	4,000,000	39,458	100	1,360,294	Oct. 1907	1.50
Utah, g.(Fish Sp'gs)	Utah	1,000,000	100,000	10	300,000	Apr. 1908	.03
Utah Con., c.	Utah	1,500,000	300,000	5	7,836,000	Apr. 1908	.50
Victoria, Utah.	Utah	250,000	250,000	1	177,500	Mar. 1907	.04
Vindicator Con., g.	Colo.	1,500,000	1,500,000	1	1,830,000	Apr. 1908	.04
Wolverine, c.	Mich	1,500,000	60,000	25	4,800,000	Apr. 1908	5.00
Work, g.	Colo.	1,500,000	1,500,000	1	165,000	Apr. 1908	.01
YankeeCon	Utah	500,000	500,000	1	157,500	Oct. 1907	.03
Yellow Aster, g.	Cal	1,000,000	100,000	10	958,789	Aug. 1907	.20

*Previous to consolidation $1,436,250 were divided. †Amalgamated.

Coal, Iron and Other Industrials—United States.

Name of Company and Location.	Author. ized Capital.	Shares. Issued	Par Val. $	Dividends. Total to Date.	Latest. Date.	Amt.
Ala. Con., C. & I., pf.	Ala	$2,500,000	24,638	100	$905,265	May 1905	$1.75
Allis-Chalmers, pf.	U. S	25,000,000	200,000	100	3,213,750	Feb. 1904	1.75‡
Amer. Ag. Chem., pf.	U. S	20,000,000	181,530	100	9,002,752	Apr. 1908	3.00
American Cement	Pa.	2,000,000	200,000	10	1,168,000	Jan. 1908	.30
American Coal	Md	1,500,000	50,000	25	2,367,500	Sept. 1907	1.25
Associated Oil	Cal	21,000,000	21,000,000	1	630,000	Aug. 1905	.01
Bethlehem Steel, pf.	Pa.	15,000,000	150,000	100	900,000	Nov. 1906	.75
Cambria Steel	Pa.	50,000,000	900,000	50	9,337,500	Feb. 1908	.75
Caribou Oil.	Cal	100,000	80,000	1	56,000	July 1905	.07
Central C. & C., com.	Mo	5,125,000	51,250	100	2,229,375	Apr. 1908	1.50
Central C. & C., pf.	Mo	1,875,000	18,750	100	1,359,378	Apr. 1908	1.25
Central Oil	W. Va.	1,500,000	60,000	25	182,500	May 1904	.25
Claremont Oil	Cal	500,000	450,000	1	58,500	June 1905	.01
Col. & Hock. C.& I,pf.	Ohio	7,000,000	69,244	100	383,818	Apr. 1908	1 50
Consolidated Coal	Ill.	5,000,000	50,000	100	350,000	July 1904	1.00
Consolidation Coal	Md.	10,250,000	102,500	100	9,621,650	Jan. 1908	3.50
Crucible Steel, pf	Pa.	25,000,000	250,000	100	2,125,000	June 1907	1.50
Empire S. & I., pf.	N. J	2,500,000	25,000	100	820,533	Jan. 1908	3.00
Fairmont Coal,	W. Va.	12,000,000	120,000	100	2,100,000	Jan. 1908	2.00
Four Oil	Cal	500,000	300,000	1	105.40	July 1905	.01
General Chem. Com.	U. S.	12,500,000	74,103	100	2,041,537	Mar. 1908	1.00
General Chem., pf.	U. S.	12,500,000	100,000	100	5,140,178	Apr. 1908	1.50
George's C'k Coal	Md	2,500,000	22,000	100	1,188,000	July 1904	3.00
Imperial Oil	Cal	1,000,000	100,000	100	880,000	July 1905	.20
International Salt.	Penn.	30,000,000	182,280	100	927,060	Dec. 1906	1.00
Jeff. & Cl'f C. & I., cm	Pa.	1,500,000	15,000	100	330,000	Aug. 1905	5.00
Jeff. & Cl'f. C. & I., pf.	Pa.	1,500,000	15,000	100	938,000	Feb. 1908	2.50
Kern River Oil	Cal	2,000,000	20,000	100	39,500	May 1905	.13
Lehigh Coal & Nav.	Pa.	17,378,500	346,901	50	27,002,297	May 1908	2.00
Maryland Coal,pf.	Md	2,000,000	18,850	100	1,667,960	Jan. 1908	4.00
Monon R. Coal, pf.	Pa.	10,000,000	100,000	100	3,854,945	Jan. 1908	3.50
National Carbon, pf.	U. S.	4,500,000	45.000	100	2,047,500	May 1905	1.75
National Lead, com.	N. Y.	15,000,000	149,054	100	2,533,919	Apr. 1908	1.25
National Lead, pf.	N. Y.	15,000,000	149,040	100	17,111,788	Mar. 1908	1.75
Nat'l Steel & Wire,pf.	N. Y.	5,000,000	25,778	100	631,561	May 1906	1.75
New Central Coal	Md.	1,000,000	50,000	20	350,000	May 1907	.40
New River Coal, pfd.	W. Va.	4,000,000	37,617	100	225,702	Nov. 1907	1.50
Pacific Coast Borax.	Cal	2,000,000	19,000	100	2,086,500	Aug. 1905	1.00
Peerless Oil	Cal	1,000,000	92,000	10	396,320	May 1905	.14
Penna. Salt.	Pa.	3,000,000	60,000	50	14,918,000	Apr. 1908	3.00
Penna. Steel, pfd.	Pa.	25,000,000	168,214	100	8,204,493	Nov. 1907	3.50
Phila. Gas, com	Pa.	28,953,029	579,061	50	8,484,336	Nov. 1907	.75
Phila. Gas, pf.	Pa.	6,000,000	120,000	50	2,700,000	Mar. 1908	1.25
Pittsburg Coal, pf.	Pa.	32,000,000	297,010	100	11,434,962	Apr. 1905	1.75
Pocahontas Coll., pf.†	W. Va.	2,800,000	28,000	100	84,000	Jan. 1908	3.00
Pocahontas Coll.,cm†	W. Va.	4,520,000	45,200	100	135,600	Oct. 1907	3.00
Republic I. & S., pfd.	Ill.	25,000,000	204,169	100	6,045,338	Apr. 1908	1.75
Sloss-Sheffield, com.	Ala	10,000,000	100,000	100	1,625,000	Mar. 1908	1.25
Sloss-Sheffield, pf.	Ala	10,000,000	67,000	100	3,517,500	Apr. 1908	1.75
Standard Oil.	U. S.	100,000,000	970,000	100	605,272,905	Mar. 1908	15.00
Tenn. C. & I., com	Tenn	22,553,600	225,536	100	3,583,060	Nov. 1907	1.00
Tenn. C. & I., pf.	Tenn	248,000	2,480	100	390,040	Nov. 1907	2.00
Texas & Pacific Coal.	Texas	2,500,000	23,940	100	1,663,830	Dec. 1908	1.50
United Metals Selling	U. S.	5,000,000	50,000	100	5,125,000	Apr. 1908	5.00
U. S. SteelCorp.,cm.	U. S.	550,000,000	5,083,025	100	73,666,079	June 1908	.50
U. S. Steel Corp., pf.	U. S.	360,281,100	3,603,141	100	206.371.215	May 1908	1.75
Va. Carolina Ch., pf.	U. S.	20,000,000	180,000	100	13,260,869	Apr. 1908	2.00
Warwick I. & S.	U. S.	1,500,000	145,581	1	473,138	Nov. 1907	.30
Westmoreland Coal.	Pa.	3,000,000	60,000	50	8,730,000	Apr. 1908	2.50

Canada, Mexico, Central and South America.

Name of Company and Location.	Author-ized Capital.	Shares. Issued.	Par Val. $	Dividends Total to Date.	Latest. Date.	Amt.
Amistad y Conc'rdia.	Mex	$480,000	9,600	50	$258,064	Jan. 1905	$1.71
Batopilas	Mex	9,000,000	446,268	20	† 55,784	Dec. 1907	.12½
British Columbia, c.	B. C	3,000,000	503,000	5	201,200	Sept. 1907	.40
Buffalo, s.	Ont.	1,000,000	900,000	100	189,000	Apr. 1908	.08
Butters' Salvador, g.	Salv	750,000	150,000	5	600,000	Apr. 1905	.25
Coniagas (Cobalt)	Ont.	1,000,000	1,000,000	1	20.000	July 1907	.02
Consolidated M & S.	B. C	5,500,000	53,552	100	781,885	Nov. 1907	1.25
Crow's Nest Pass	B. C.	4,000,000	160,000	25	2,018,648	July 1907	.62½
Dominion Coal, com.	N. S.	15,000,000	150,000	100	2,700,000	Apr. 1908	1.00
Dominion Coal, pf.	N. S.	3,000,000	30,000	100	‡630,000	Feb. 1908	3.50
Dos Estrellas, g. s.	Mex	150,000	3,000	50	1,020,555	July 1905	13.65
El Oro, g. s.	Mex	5,750,000	1,080,000	5	4,600,800	Jan. 1908	.36
Esperanza, s. g.	Mex	2,275,000	455,000	5	8,426,150	Apr. 1908	1.09
Foster Cobalt, s.	Ont.	1,000,000	1,000,000	1	50,000	Jan. 1907	.05
Granby Con.	B. C.	15,000,000	135,000	100	2,968,630	Sept. 1907	3.00
Greene Con. Copper.	Mex	8,640,000	864,000	10	6,137,800	Mar. 1907	.40
Greene Con. Gold.	Mex	5,000,000	500,000	10	300,000	July 1905	.20
GreenGold-Silv'r,pfd.	Mex	3,000,000	300,000	10	120,000	Mar. 1907	.40
Guanajuato	Mex	3,000,000	540,000	5	74,250	Oct. 1906	.07
Guggenheim Expl.	Mex	17,000,000	105,000	100	4,222,500	Apr. 1908	2.50
Hinds Con., g.s.c.l.	Mex	5,000,000	5,000,000	1	100,000	Feb. 1908	.02
Kerr Lake, s.	Ont.	3,000,000	600,000	5	570,000	Apr. 1908	.15
LeRoi No. 2, g.	B. C.	3,000,000	120,000	25	774,000	Mar. 1908	.48
McKinley-Darragh,s	Ont.	2,500,000	2,000,000	1	180,000	Jan. 1908	.04
Mexican Coal & Coke	Mex	5,000,000	50,000	100	600,000	Dec. 1905	3.00
Mex. Con. M. & S. Co.	Mex	2,500,000	240,000	10	660,000	Mar. 1908	.25
Mines Co. of Am.	Mex	2,000,000	2,000,000	1	3,025,000	Mar. 1908	.02
N. Y. & Hond. Ros.	C. A.	1,500,000	150,000	10	2,697,000	Apr. 1908	.10
Nipissing, s.	Ont.	6,000,000	1,200,000	5	1,680,000	Apr. 1908	.15
North Star	B. C.	1,500,000	1,300,000	1	351,000	Dec. 1904	1.00
N. S. St. & Coal, com.	N. S.	5,000,000	49,876	100	1,087,856	Apr. 1908	1.50
N. S. St. & Coal, pf.	N. S.	1,080,000	10,300	100	437,750	Apr. 1908	2.00
Penoles*	Mex	250,000	2,500	100	8,630,000	Dec. 1907	20.00
Platanillo	Mex	500,000	206,989	1	5,580	Sept. 1906	.00
Reco, g. s.	B. C.	1,000,000	958,000	1	327,082	Apr. 1906	.02
Silver Queen, s.	Ont.	1,500,000	1,500,000	1	120,000	Jan. 1907	.08
Slocan Star	B. C.	500,000	500,000	1	575,000	Dec. 1904	.66
Tezuitlan Copper	Mex	1,000,000	10,000	100	.....	Apr. 1908	1.50
Tilt Cove, c.	N. F.	1,000,000	89,000	2	21,360	Jan. 1905	.48
Tretheway, s.	Ont.	1,000,000	1,000,000	1	80,000	Mar. 1907	.04
Tyee, c	B. C.	940,000	180,000	5	136,800	Dec. 1904	.24

*Mexican Currency. †Since reorganization. ‡Since August, 1905.

Strength of Chain Links

O. A. Goodenough and L. E. Moore, in Bulletin 18, of the Engineering Experiment Station of the University of Illinois, describe a series of experiments on chain links and circular rings, covering a period of two years, made for the purpose of confirming or disproving a theoretical analysis of the stresses in links and rings. A comparison of calculated and measured distortions affords the desired test. The result of the experiments confirms the analysis. Having a reliable theory, the bending moments and maximum stresses are calculated for links of various forms and the results of such calculations are applied to the formulas for the loading of chains given by Unwin, Bach, and Weisbach.

It is shown that the usual formulas for chain loads give maximum tensile stresses of 33,000 to 40,000 lb. per sq.in., and maximum compressive stresses of 60,000 lb. per sq.in. New formulas for safe loads are proposed.

Construction News

Isoline, Tennessee—The Clear Creek Coal and Lumber Company is preparing to open coal mines and will need machinery of various kinds. W. V. Smith, Wheeler building, Columbus, O., is president; A. D. Eatherly, Isoline, Tenn., is superintendent.

Central City, Kentucky—The Kentucky Midland Coal Company is opening a new mine and needs additional machinery and mine equipment. M. M. Wheeler, Central City, Ky., is engineer in charge.

Trade Catalogs

H. K. Porter Company, Pittsburg, Penn. Light Locomotives. Pp. 224, indexed, illustrated; cloth, 6x9 inches, 1908.

F. W. Braun, 409-415 East Third street, Los Angeles, Cal. Braun's Rock Drill Forge. Pp. 4, illustrated, paper, 6½x6½ in.; 1908.

Minneapolis Steel & Machinery Co., Minneapolis, Minn. Pamphlet. Engineer's Twin City Corliss Book. Pp. 26, illustrated, paper, 6x9 n.

Geo. G. Blackwell Sons & Company, Ltd., Liverpool, England. Catalog No. 3. Alloys for steel. Illustrated, 62 pages, 4x5½ inches, paper.

United States Reduction and Refining Company, Colorado Springs, Colo. Catalog. Standard zinc-lead white. Illustrated, 5½x7½ inches, paper.

The Atlas Car and Manufacturing Company, eveland, Ohio. Bulletin No. 1065. Side ump cars. Illustrated, 20 pages, 6x9 inches' paper.

The Allentown Rolling Mills, Allentown, Pa. Bulletin, Pump Data No. 11. Electric boiler eed pump. Illustrated, 16 pages, 6x9 inches, paper.

Allis-Chalmers Company, Milwaukee, Wis. Bulletin No. 1406. Ball Mills. Illustrated. Bulletin No. 1513. Portable air compressors. Illustrated.

International Steam Pump Company, 115 Broadway, New York. Bulletin BK-810. Steam heating vacuum pumps. Illustrated, 4 pages, 6x9 inches.

Hawley Down Draft Furnace Company, Chicago, Ill. The Schwartz Metal Melting and Refining Furnaces. Pp. 80, illustrated; paper, 8½x10½ inches.

The J. Geo. Leyner Engineering Works Company, Littleton, Colo. Bulletin No. 514. Drill Sharpeners, Oil Furnaces, Coke Furnaces. Pp. 24, illustrated, paper, 6x9 in.

United States Gas Furnace Company, Providence, R. I. Gas Blast Furnaces, Pressure Blowers, Pyrometers, High Speed Steel Furnaces. Pp. 12, illustrated, paper, 6x9 in.; 1908.

Bruce-Meriam-Abbott Company, Cleveland, Ohio. Catalog A, Section I. Vertical Gas Engines for Electric Lighting, Pumping and General Power Purposes. Pp. 16, illustrated; paper, 6x9 in.; 1908.

Industrial

Baker & Company, Inc., have removed their New York office to the Hudson Terminal building, Cortlandt and Church streets, New York.

The San Francisco office of the Allis-Chalmers Company has been removed from the Atlas building to the Phillips building, 599 Mission street.

The Hendrie & Bolthoff Manufacturing and Supply Company have published a list of odd stock and second-hand machinery and supplies which they offer for sale at reduced prices. They state that many of the odd stock articles are new and offered at exceedingly low prices.

The "Engineering Record" has published a very excellent and complete directory of manufacturers of and dealers in engineers' and contractors' machinery and supplies. It can be readily carried in the pocket and should prove of inestimable value to the readers of that publication.

H. W. Johns-Manville Company inform us that they are about to open a new branch office in Detroit, Mich., which will be located at 72 Jefferson avenue, under the management of Willard K. Bush. A complete stock of goods will be carried, so that shipments can ordinarily be made direct from Detroit.

The Smooth-On Manufacturing Company, Jersey City, N. J., has issued an interesting circular about the Smooth-On gasket. The company also advises us that it will send a sample Smooth-On-coated corrugated gasket free to any mining engineer, manager or superintendent who sends his name and business address.

Sales managers of mine machinery and supply houses should write for "What Makes the Best Advertising Medium?" to Emerson P. Harris, 253 Broadway, N. Y. There is much good horse sense and wise advice based on experience. It does not mention this paper, but we wish every man who authorizes or places advertising might read it for his own benefit.

The Canadian Crocker-Wheeler Company Ltd., has been organized to make and sell in Canada the Crocker-Wheeler electric apparatus and appliances. The officers are F. E. Lovell, Coaticooke, P. Q., president; Russell A. Stinson, vice-president; F. John Bell, secretary and treasurer. The office is in the Street Railway chambers, Place d'Armes hill, Montreal.

Abendroth & Root, Newburgh, N.Y., makers of the Root spiral-riveted pipe, have completed an addition to their plant which increases its capacity by one-third. They have supplied a large quantitity of the pipe used in building the Pennsylvania tunnels under the Hudson and East rivers at New York. They recently shipped three Root water-tube boilers for use in the Panama canal work.

The Goldschmidt Thermit Company, New York, has established an office and works at 103 Richmond street, W., Toronto, Canada. The new branch is under the management of E. C. Rutherford, of Toronto. A complete stock of thermit and appliances will at all times be carried at Toronto, and a fully equipped repair shop will be in operation for the repair of steel castings up to 1000 lb. weight.

Robert W. Hunt & Co. have established an analytical chemical laboratory in connection with their St. Louis office, 1445 Syndicate Trust building. Particular attention will be given to analyses of and advice on iron-foundry mixtures. This laboratory will be under the direction of J. B. Emerson, recently in charge of the metallurgical part of the wheel foundry of the Mt. Vernon Car Company, and formerly with the Illinois Steel Company.

The Minneapolis Steel and Machinery Company has issued a copyrighted booklet on the "Twin City" Corliss engine which is quite unique. The system of numbers and names which are used has very much simplified the matter of ordering repairs and spare parts and the book should prove to be of great value. Any engineer, manager or superintendent may have a copy by sending his name and address to the main office in Minneapolis, Minn.

A test of the machinery in the steel-rail mill in the big plant of the Tennessee Coal, Iron and Railroad Company at Ensley, Ala., was made last week and proved satisfactory. All work of improvement and development at this place is being rushed. Announcement is made on semi-official authority that there will be a general resumption of operations at the steel plant about June 15. The rolling mills of the Tennessee company at Bessemer, 12 miles south of Birmingham, are being put in readiness for operation, some orders having recently been received.

The United Roofing and Manufacturing Company advises us it will supply samples of Congo roofing on request. After a man has done some work with ready roofings he begins to look for flexibility in his material. So many roofings are stiff as boards and hard to handle. Bending them properly over the eaves, cutting them to fit the roof or folding the thick sheets in the corners is often difficult to do correctly. Congo is extremely pliable under all climatic conditions. It can easily be folded double and will lie snug and close, making a tight waterproof roof.

Considerable interest is being taken in a recent invention (patented by Chas. E. Arnold, of Wilmington, Del.), which relates to a process for quenching coke without the direct use of water, whereby an absolutely dry coke is produced that greatly exceeds in strength coke of ordinary manufacture. The natural inference is that many coals now unfit for furnace coke will be made available, due to this method of quenching, and that many coal deposits in Illinois, Indiana and elsewhere, now considered unfit for coking purposes, may be found by this process to produce a satisfactory blast-furnace coke.

Our readers are warned respecting a man about 30 years old, 5 ft. 8 high, of slender build, light complexion, crooked teeth, who speaks with an English accent, claims to be connected with various important men engaged in the electrical and mechanical field in England. He generally has a hard luck story and borrows money which is never returned. He is using a number of aliases and has operated all over the country. We are informed that he is at present in New York, but recently has been heard from in Philadelphia, Rochester and other eastern cities.