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EMPLOYERS in any part of the world who require the services of superintendents, mining or civil engineers, metallurgists, chemists, mine or furnace foremen, or other assistance of this character, can have their wants advertised in the ENGINEERING AND MINING JOURNAL without charge.

MR. FREDERICK G. CORNING, mining engineer, of New York, has gone to the San Juan District, Colo., to examine mining property for a New York syndicate. He expects to be absent for about a month. His address in Colorado is Silverton, or care of Gov. J. B. GRANT, Denver, Colo.

THROUGH the courtesy of the several companies, we are enabled to give on the following page the value of the bullion output of gold, silver, and copper by 80 mines in 1885. During the same year, no less than 37 of these mines declared dividends to the aggregate amount of \$7,848,577. The compilation of production statistics is a difficult work, and it has been only with great efforts and persistence that we have succeeded in collecting the figures contained in this table, which, though far from complete, yet covers the production of the most important mines, and those in which the public has the greatest interest.

THE work of searching for the bodies of the men buried in the Nanticoke mine December 18th last was, as we think wisely, discontinued a few days ago, on account of the imminent danger to the workmen employed. It appears that the miners oppose the suspension of this work, and demand of the company to continue the search. No doubt this will be done, if the men will assume the responsibility for any further loss of life. It is, of course, a painful thing to be obliged to leave the bodies in the mine, and the company has shown the greatest desire to recover them, and has spared no expense to effect this; but the safety of the living is far more important than the recovery of the dead bodies, and unless the company be held free from the consequences, it might very well refuse to allow men to work when the danger is so great.

We note also that the bore-holes put down from the surface confirm our supposition that the roof was all washed away at the point where the cave occurred.

A NEW WORK ON AMERICAN STEEL MANUFACTURE.

The progress that has been made in many branches of metallurgy during the past decade has rendered our text-books in a great measure useless, because they do not treat of the methods now in use. In fact, many treatises on metallurgy begin as near the days of TUBAL CAIN as mythical history will allow, and they stop usually at the practice of twenty years ago. While some treatises are unquestionably extremely valuable to the student as expositions of the chemistry of metallurgical operations and as historic works, they are nearly all so far behind the present practice, and give so little information concerning the actual methods and appliances used in the present state of the art, that they are of little value to our busy engineers, and give no idea of the facts that are rapidly placing, nay have already placed, American metallurgists and engineers in advance of those from any other part of the world.

This is now very generally recognized, and in the metallurgy of gold, of silver, of lead, and even of copper and some other metals, American practice is admitted to excel that of Europe. In iron and steel, when the facts are fully known, they will show that American practice also attains results not reached elsewhere.

The progress in the art of steel making and manufacture has been marvelous during the past ten years, and no publication exists to-day in any language that gives an idea of its present status.

It is, therefore, with great pleasure that we announce the early publication in the columns of the ENGINEERING AND MINING JOURNAL of a work on AMERICAN STEEL MANUFACTURE that will give the actual present state of the art. This extremely valuable work is being prepared for us by the well-known metallurgical engineer, Mr. HENRY M. HOWE, who is universally recognized as probably the most competent engineer in America for the special work in question.

It is our desire to make this treatise in every respect worthy of the subject and the profession, and Mr. HOWE, aided by the courteous co-operation of our steel manufacturers, which has everywhere been extended to him, will be enabled to give information of the utmost practical value to those engaged in this industry.

The treatise will contain working drawings of the very latest forms of furnaces and machinery used in steel manufacture, and details of cost, investigations of the properties of different steels, etc., etc.

CORRESPONDENCE.

[We invite correspondence upon matters of interest to the industries of mining and metallurgy. Communications should invariably be accompanied with the name and address of the writer. Initials only will be published when so requested. All letters should be addressed to the MANAGING EDITOR. We do not hold ourselves responsible for the opinions expressed by correspondents.]

Treatment of Lead-Zinc Ores.

EDITOR ENGINEERING AND MINING JOURNAL:
SIR: In reply to your correspondent, J. W. Scott,* in your issue of the 30th ult., without doubt the best and most economical mode of smelting and utilizing the zinc and argentiferous lead ores of which he speaks is by the "Lewis-Bartlett" process, a full account of which was given in the ENGINEERING AND MINING JOURNAL of July 4th, 1885.

I am managing a works here built under the Lewis-Bartlett patents, where ores of the above class have been successfully treated. We reduce a large proportion of the galena to pig-lead, and the remain-

* Mr. Scott's address is Tyrone, Pa.

der, with the zinc, is converted into a "white lead" composed of sulphate and oxide of lead and oxide of zinc, which commands a high price and ready sale in the market.

I shall be happy to give your correspondent any further particulars.
Yours truly,
JOHN M. BEVAN.
SHIREHAMPTON, NEAR BRISTOL, ENGLAND, Feb., 1886.

Copper Mines of Butte, Montana.

EDITOR ENGINEERING AND MINING JOURNAL:

SIR: Beyond any doubt, the production of copper at Butte is slightly falling off. The Anaconda's mines are worked for all they are worth. It is claimed that the 800-foot level looks very well, but it ought to contain large ore-bodies; otherwise, it would be difficult to provide material for the large smelting plant for any great length of time. The high-grade ore-bodies are well-nigh exhausted, and the ores fit for concentration are gradually becoming lower grade, which of course was to be expected. The average of copper contents of these low-grade ores will hardly reach 10 per cent. The shaft is sunk to 1000 feet, and the company is cross-cutting in the 900 and 1000-foot levels for the vein, which has not yet been encountered.

Parties supposed to be connected with the Anaconda Company are quietly buying up properties claimed or expected to be copper mines. This is especially the case with the Modoc, the Modoc Extension, Adelaide, Celia, and others. So far during the past few years, a good deal of money has been spent on those properties, but they did not show satisfactory results.

The Parrot mine has still some ore-reserves, in the upper levels. In the 430-foot level, both parallel veins have been reached and are expected to contain a fair grade of ore.

The Clark's Colusa Fraction has only small ore-reserves left. Sinking to the 450-foot level has begun. Mr. Clark leased the adjoining 75 feet from the Liquidator Company, and paid \$25,000 for the right to take out all ores left between the 300-foot level and the surface. Both parties claim to have made a good bargain.

The Mountain Chief mine is worked on a small scale, and very little copper ore is taken out, though it is rich in silver.

The Liquidator mine is in a very bad condition. An immense cave occurred last week, every thing between the west 200 and 300-foot levels for a distance of 70 feet going down, crushing timbers as though they were pipe-stems. The whole surface ground is unsafe, and probably part of the adjoining Clark's Colusa Fraction will ultimately come to grief.

The Montana Copper Company, since the Bain incident and the arrival of Mr. Raunheim, has not created any sensation. Its smelting-works are still shut down. The reason is said to be that the company does not propose to exhaust its mines at the present low prices of copper. This course may be satisfactory to the company, but is certainly not popular here.

Its Colusa mines look very favorable. The West Colusa is said to show large ore-bodies in all levels. In the East Colusa, drifting and cross-cutting in the 800-foot level continues, and it is expected to tap the vein within a few days. The upper levels contain large ore-reserves.

The Mountain View, located between the Anaconda and the West Colusa, forms the connecting link between these two large copper properties. It is owned by Mr. Larabie, who is only doing prospecting work, but has opened a big ore-body in the 500 and 600-foot levels. He does not sell his ores at the present prices. The Gagnon, Wild Bill, and Clear Grit mines produce only low-grade copper ores, but rich in silver.

NICK.

PRODUCTION OF LEAD IN THE UNITED STATES IN 1885.

We are indebted to Mr. Albert Williams, Chief of Division of Mineral Statistics, for the following report by Mr. Charles Kirchhoff, Jr., on the production of lead in the United States in 1885:

Complete returns from every desilverizing works in the country show the production of lead in 1885 to have been as follows, as compared with previous years in which this office has gathered the data:

YEAR.	Desilverized lead.		Total production.
	Short tons.	Non-argentiferous lead. Short tons.	
1882.....	103,875	29,015	132,890
1883.....	122,157	21,800	143,957
1884.....	119,965	19,932	139,897
1885.....	108,692	21,975	130,667

For the producing section in Missouri, Kansas, Illinois, and Wisconsin, the estimate of 21,750 tons, made by Messrs. John Wahl & Co., of St. Louis, has been accepted. No allowance was made in 1885 for the quantity of lead in Missouri and Kansas or purchased by desilverizers.

It must be noted that the receipts of desilverizers upon which the estimate of production is based were in 1885 increased by stocks of base bullion carried over from 1884 product, notably by Leadville smelters, but forwarded in 1885. The actual output of lead in the country was therefore somewhat less even than the return shows, say 128,000 to 129,000 short tons, indicating a very heavy decline.

Consumption called for a larger quantity, and stocks were drawn upon. It is estimated by good authority that thus a stock of 17,000 tons on January 1st, 1885, was reduced to 6000 tons on January 1st, 1886.

Soaking-Pits for Tires.—The Osnabrück Steel-Works is making use of "soaking-pits" for the slow and uniform cooling of tires after rolling. The pits used are constructed in the ground, in the usual manner, of fire-brick material, and are of such a size that they hold twelve tires, one placed on top of the other. The tires, as soon as they are rolled, are taken to the pits by means of traveling cranes, and are left to cool for three or four days in the closed pits. Experiments have proved that tires cooled in this way have 50 per cent greater strength than those cooled in the usual manner in ashes or simply exposed to the air.

VALUE OF THE GOLD, SILVER, COPPER AND LEAD PRODUCED BY THE PRINCIPAL AMERICAN MINES, AND DIVIDENDS IN 1885.

MINES.	Location.	Production 1885.	Dividends 1885.
Adams, s. l.	Colorado	\$366,099	\$217,500
Alice, g. s.	Montana	† 1,175,768	125,000
Allouez, c.	Michigan	† 238,752	
Anaconda, c.	Montana	† 3,500,000	
Arizona Copper, c.	Arizona	† 712,800	
Atlantic, c.	Michigan	† 399,238	20,000
Bell, c.	Montana	† 200,070	
Belleveu Idaho, s. l.	Idaho	330,418	87,500
Belmont, s.	Nevada	10,003	
Big Bend Hydraulic, g. s.	Dakota	30,000	30,000
* Bodie, g.	California	48,633	50,000
* Bodie Tunnel, g.	California	5,910	
Boston & Montana, g.	Montana	610,358	30,000
Caledonia, g.	Dakota	142,934	20,000
Calumet & Hecla, c.	Michigan	† 5,181,000	1,700,000
* Camas No. 2, g.	Idaho	9,208	
Catalpa, s.	Colorado	28,395	
Central, c.	Michigan	† 238,067	30,000
Christy, s.	Utah	249,680	
Chrysolite, s.	Colorado	117,402	
Colorado Central, s.	Colorado	311,201	60,000
Consolidated Bortail, g.	Colorado	40,851	
Consolidated Pay Rock, s.	Colorado	53,726	
* Contention, g. s.	Arizona	287,173	
Coppe Falls, c.	Michigan	† 121,000	
Copper Prince, c.	Arizona	† 80,000	
Copper Queen, c.	Arizona	† 701,201	
Deadwood Terra, g.	Dakota	441,491	
Derbec Blue Gravel, g. s.	California	154,208	40,000
Detroit Copper, c.	Arizona	† 360,000	
Elkhorn, g. s.	Montana	185,070	35,000
Eureka Consolidated, s. l.	Nevada	343,595	
Father de Smet, g.	Dakota	381,697	200,000
Franklin, c.	Michigan	† 442,335	40,000
Freeland, g. s.	Colorado	338,998	80,000
* Grand Central, g. s. c.	Arizona	638,078	
Grand Prize, s. g.	Nevada	89,338	
Granite Mountain, s.	Montana	1,146,000	580,000
Head Center Consolidated, s.	Arizona	† 26,533	
Head Center & Tranquility, s. g.	Arizona	85,469	
Hecla Consolidated, g. s. l. c.	Montana	851,100	195,000
Helena, g. s. l. c.	Montana	1,243,977	138,300
Homestake, g.	Dakota	1,307,040	525,000
Hope, s.	Montana	129,045	
Horn-Silver, s. l.	Utah	238,369	
Huron, c.	Michigan	† 245,806	
Iron Hill, g. s.	Dakota	25,918	
Iron Silver, s. l.	Colorado	660,109	200,000
Ken'uck, s.	Nevada	† 6,240	
* Kohnoor & Donaldson, g. s.	Colorado	63,906	
Lexington, g. s.	Montana	836,686	80,000
Little Chief, s. l. l.	Colorado	25,221	20,000
* Mono, g.	California	5,976	
Montana Copper, c.	Montana	† 750,000	
Montana Limited, s. g.	Montana	876,138	123,750
Moulton, s. c.	Montana	805,585	150,000
Mount Diablo, s.	Nevada	325,231	30,000
Navejo, s. c.	Nevada	82,894	50,000
New Hoover Hill, s. g.	North Carolina	68,400	37,200
New Pittsburg, s.	Colorado	41,194	
North Belle Isle, s.	Nevada	2,118	
Old Dominion, c.	Arizona	† 488,400	
Ontario, s.	Utah	2,316,387	975,000
Oscuela, c.	Michigan	† 208,558	
Parrot, c.	Montana	† 980,060	
Plymouth Consolidated, g.	California	880,528	575,000
Plutus, g. s. c.	Colorado	31,517	
Quincy, c.	Michigan	† 642,337	180,000
Rooks, g.	Vermont	28,383	30,000
Ropes, g. s.	Michigan	30,592	
Silver King, s.	Arizona	743,201	200,000
Small Hopes, s. l.	Colorado	1,134,108	887,560
South Yuba Water and Mining, g. w.	California	82,107	
St. Joseph's, l.	Missouri	680,000	66,000
Standard Consolidated, g.	California	207,680	
Stormont, s.	Utah	174,406	
Syndicate, g.	California	93,759	12,077
Tombstone, g. s. l.	Arizona	† 541,776	
Valencia Mica, m.	New-Hampshire	50,000	16,750
* Yankee Girl, s.	Colorado	320,000	?
Total.....		\$36,157,206	\$7,848,577

G., gold; S., silver; L., lead; C., copper; M., mica. W., water. Silver valued by the different companies from \$1 to \$1.29 per ounce; gold, \$20.67. * Not official. † Assay value. ‡ Royalty. § Net. || Received from milline. ¶ Lake copper valued at 11 cents and other copper at 10 cents. The quantity produced by each copper mine in 1885 was in this JOURNAL for January 30th, 1886. Lead at 4 cents. The dividends paid by a number of companies that have not reported production will be found in the JOURNAL for January 9th, 1886. The reports given above are, for the most part, official.

The Brückner Cylinder in Montana.—From a letter of Mr. E. A. Weinberg, Acting Superintendent of the Anaconda Smelting-Works, Montana, addressed January 1st, 1886, to Mr. William Brückner, we take the following estimate of the cost of operating the Brückner cylinder at those works, per twenty-four hours:

2 3/4 cords of wood.....	\$11.00
2 men.....	7.00
Oil, etc.....	.20
Total.....	\$18.20

Since the working capacity of the cylinder is 8 1/2 tons roasted daily (of concentrated material containing from 37 to 40 per cent of sulphur), the cost per ton, apart from power, is \$2.14. Mr. Weinberg adds that two men could very well attend to three double-cylinder furnaces, according to Mr. Brückner's improved design, and that such a system would bring out the real economical superiority of the cylinders, as compared with reverberatories. Mr. Brückner, however, proposes to arrange six cylinders in two furnaces instead of three; and the following is his estimate of the cost of operating two such three-cylinder furnaces, based on the figures of actual practice given by Mr. Weinberg:

5 1/4 cords of wood.....	\$22.00
2 men.....	7.00
Oil, etc.....	.60
Total.....	\$29.60

being \$4.94 per cylinder, or, apart from power, for a daily capacity of 51 tons (from 37 to 40 per cent sulphur) roasted, 58 cents per ton.

THE CALORIFIC POWER OF ILLUMINATING GAS.*

By Aimé Witz.

The investigation of the calorific value of a gas destined for illuminating purposes would be unnecessary if it were not at the same time employed for producing heat and work; but it may be assumed that, in the future, gas will be more employed for heating purposes and for motive power than for lighting, and the study of its calorific properties possesses, therefore, considerable interest. The author is not aware that any accurate determinations have been made on this point. In Accum's treatise on gas-lighting, an experiment on the subject is described, which consists in burning the gas under a vessel containing a known quantity of distilled water, and observing the rise in temperature obtained by the combustion of a given quantity of gas; according to this author, 97 cubic inches of gas produced an increase of 50 degrees Fahrenheit in 3½ pounds of water; the calorific power per cubic meter would, therefore, be 10,000 calories, but this is manifestly too high. Mr. F. Fischer, a German philosopher, has recently adopted a similar plan for determining the comparative values of gas-burners; under the most satisfactory practical conditions, 0.974 cubic foot of gas was required to heat 2.2 pounds of water from 32 degrees to 212 degrees Fahrenheit; and Mr. Lefebvre, one of the engineers of the Paris Gas Company, has found the minimum consumption of gas for the same result to be 1.126 cubic feet. The available heat in gas-furnaces would, therefore, be at most equal to 3600 calories per cubic meter. If the coefficients of effect of the burner and boiler were known, the actual calorific power of the gas could be deduced from these figures, but this method of valuation would be very indirect, and consequently inaccurate. Mr. Dugald Clerk has also estimated 504,888 and 489,268 foot-pounds per cubic foot as the mechanical equivalents of Manchester and London gas, which correspond to 5640 and 5372 calories per cubic meter. It has hitherto been the general practice to accept 6000 calories per cubic meter as the average calorific power of gas, but the results of the author's researches indicate a considerably lower value.

The heat of combustion of gases has generally been estimated by their slow combustion in metallic vessels immersed in a calorimeter, but this plan is extremely tedious and liable to error. Mr. Berthelot introduced a more direct and more accurate method, consisting of the instantaneous combustion of an explosive mixture in a closed vessel plunged in the water of a calorimeter, and observing very accurately the elevation of temperature; this plan was adopted in its general principles by the author. The explosion-chamber consisted of a nickel-plated steel cylinder, 2.36 inches internal diameter, and 3.54 inches high, the thickness of the metal being about 0.079 inch, and having a capacity of 15.56 cubic inches, with top and bottom covers screwed on so as to render the cylinder air-tight, a wire being passed through the top cover for the introduction of an electric spark, and the bottom cover fitted with a valve for filling and emptying. The calorimeter for the reception of the cylinder is nearly 4 inches diameter and 8 inches high; it requires 1.76 pints of water to submerge the cylinder; a means for agitating the water is also provided. A very sensitive and minutely divided thermometer is also required.

The cylinder is first filled with mercury, which is displaced by gas and air, or other mixtures, over the mercury bath, care being taken to reduce the mixture to atmospheric pressure by slightly raising the valve for an instant, and careful arrangements are described for accurately measuring the proportions of gas and air introduced. Before making the experiments, constants were carefully determined for allowances to be made for the absorption of heat by the various parts of the apparatus; these were made by direct experiments and verified by calculation.

As the result of a large number of experiments, made under varying conditions of time, temperature, and pressure, and with gas manufactured at various works, the author arrives at the following conclusions: The average calorific power of well-purified illuminating-gas, as generally stipulated for by the concessions of French gas companies, is about 5200 calories per cubic meter (equal to 584 British units per cubic foot); the standard of 6000 calories, generally accepted up to the present time, being therefore too high. The calorific power of gas from the same works was found to vary from 4719 calories to 5425 calories at different periods of the year; but, comparing one work with others, the variation was not great if a sufficient number of trials were made. The necessary purification of the gas reduces the calorific value by more than 5 per cent. Contrary to what is generally supposed, the gas produced during the last hour of a charge is inferior in heating power to that obtained during the first hour, but it does not sensibly lose its calorific power by contact with water. The heating power of a gas may be increased 77 per cent by carburation, but the gasoline employed becomes rapidly less volatile, and when reduced to one fourth its volume, its enriching power is only 34 per cent. One volume of gas with six volumes of air produces complete combustion, leaving no appreciable trace of carbonic oxide in the products of combustion; but with excessive dilution, the combustion is manifestly imperfect.

NOTE BY THE ABSTRACTER.—The French calorie is equal to 3.986 English heat-units. It may be mentioned that the late Mr. F. W. Hartley gave, as the result of his experiments with 15-candle gas, a calorific value of 622 English units per cubic foot. See Transactions of the Gas Institute for 1884.

A Telemicrophone.—M. Mercadier, the well-known French experimenter, has devised an apparatus that he calls a telemicrophone, and which is in reality a combined magneto telephone, and a carbon microphone transmitter. The microphone is so fixed to the iron telephone plate that the magneto currents produced by speaking to the plate are superposed upon the microphonic currents, which are also due to the vibrations of the plate. The double effect is thus obtainable at will; and the apparatus acts both as a transmitter and receiver. M. Mercadier has also fitted his apparatus with acoustical tubes which convey the sound to and from it without the necessity of putting the apparatus to the ear or mouth.

* Abstract of a paper in *Annales de Chimie et de Physique*, 1883, p. 256. From the Minutes of the Proceedings of the Institution of Civil Engineers of London, edited by James Forrest, Secretary.

THE SPECIFIC GRAVITY OF LOW CARBON STEEL.

By George S. Miller.

Discussion (Communication to the Secretary of the American Institute of Mining Engineers).

William Kent, New York City: About five years ago, I had occasion to make some determinations of specific gravity of open-hearth steel boiler-plate of analysis approximately as follows: carbon, 0.14; phosphorus, 0.03; silicon, 0.02; sulphur, 0.02; manganese, 0.30. Five pieces of plate ¼-inch thick gave these results: sp. gr., 7.9323; 7.9320; 7.9318; 7.9556; 7.9275—average, 7.9319; maximum variation, 0.0081. My notebook contains the remark made at the time, in explanation of these unusually high figures: "This steel is probably purer than any steel of which the specific gravity has ever been published."

These figures tend to confirm the two observations made by Mr. Miller, first, that the thinner plates show a lower specific gravity than the thicker; and second, that increase of impurity causes decrease in specific gravity. The latter statement seems to be correct beyond question. The former, I think, can be explained by the fact that errors in determination of specific gravity are more likely to occur in thin plates on account of their presenting a greater surface in proportion to their weight than thicker plates; the surface retaining air to some extent, which prevents the water from thoroughly wetting the piece while making the weighing in water. The pieces I used were first planed to remove all possible scale indentations, then filed smooth, then cleaned in dilute sulphuric acid, and then boiled in distilled water, to remove all traces of air from the surface. In my determination of the specific gravity of the copper-tin and copper-zinc alloys (*Reports of U. S. Iron and Steel Testing Board*, Vol. I.), I found these precautions necessary to remove the air from the pieces. In some cases, in order to obtain duplicate results, the pieces were washed in alcohol, then in distilled water, and then placed under an air-pump and the air exhausted for a long time before weighing in water.

The figures of specific gravity thus obtained by careful experiment on bright, smooth pieces of steel are, however, too high for use in determining the weights of rolled plates for commercial purposes. The actual average thickness of these plates is always a little less than is shown by the calipers, on account of the oxide of iron on the surface, and because the surface is not perfectly smooth and regular. A number of experiments on commercial plates, and comparison of other authorities, led me to adopt the figure 7.854 as the average specific gravity of open-hearth boiler-plate steel of the best quality, and to use it in a table of weights of plates, which I constructed for use in the steel-works. This figure is easily remembered as being the same figure with change of position of the decimal point (.7854) which expresses the relation of the area of a circle to that of its circumscribed square, or one fourth the ratio of the circumference to the diameter. Taking the weight of a cubic foot of water at 62 degrees Fahr. as 62.36 pounds (average of several authorities), this figure gives 489.775 pounds as the weight of a cubic foot of steel, or the even figure, 490 pounds, may be taken as a convenient figure, and accurate within the limits of the error of observation.

A common method of approximating the weight of iron plates is to consider them to weigh 40 pounds per square foot one inch thick. Taking this weight and adding 2 per cent gives almost exactly the weight of steel boiler-plate given above ($40 \times 12 \times 1.02 = 489.6$ pounds per cubic foot).

Oscillation of Chimneys.—E. Bourry, in the *Mémoires de la Société des Ingénieurs Civils*, June, 1885, page 721; abstracted in the Proceedings of the Institution of Civil Engineers of London: The amplitude of the oscillation of chimneys has been exactly measured by observation of the shadows cast by the sun upon the ground. Recently, the oscillations of a chimney 115 feet high and 4 feet in diameter externally at the top, near Marseilles, were observed, by the shadow, during a high wind, to attain a maximum of 20 inches. It was estimated that the chimney, deflected by an initial impulse, would have made four or five oscillations before returning to a state of rest. On the contrary, by a succession of impulses isochronous with the oscillations, a chimney may finally be overthrown. Such is the explanation of the destruction of certain chimneys in which, nevertheless, all the conditions of statical stability were fulfilled.

A Spectroscope for Furnaces.—An apparatus described by M. Ch. V. Zenger before the French Academy of Sciences, and termed by him the spectroscopic optometer, is available for the study of flames in the Bessemer converter and the analysis of the gas that emanates from it. With ordinary optometers, it is difficult to recognize when the aperture is seen distinctly if the light is feeble; and when the aperture is too large, the images are indistinct; when too narrow, they are interfered with by diffraction. M. Zenger has therefore made use of a lens of calc-spar, arranged so that the optical axis of the lens coincides with the principal crystallographic axis of the sphenoid. Two positions are thus found in which the aperture appears distinct and single, one for ordinary and the other for extraordinary rays. The lens having two foci, of which the lengths are almost as 1.65 to 1.48; for example, from 0.165 to 0.148 meters for extraordinary and ordinary rays, it is easy to calculate, by the known method, two values of the visual distance, of which the discord shows immediately the error committed in the experiment. Often considerable errors are found, errors of 0.01 to 0.02 meter and more for aged persons. But M. Zenger finds that the accord is good when the aperture is lighted by monochromatic light, and hence he added the spectroscope to the optometer. A mirror in which the light is reflected enables the observer to turn his back to the flame, which is a personal convenience. By placing near the mirror at visual distance a micrometer on a thin plate of mica or gypsum, the distance of the more important luminous rays can be measured with precision by taking as the point of departure the divisions corresponding to the double ray of sodium D₁ D₂. The progress of the Bessemer process can thus be followed without fatigue to the eye, and the characteristic rays of carbon, silicon, and manganese seen to appear.

LEAD SLAGS.*

By Malvern W. Iles, Ph.D.

Smelting is a chemical operation, and a study of the nature of slags forms the science of smelting. It will therefore be seen that the field is an exceedingly broad one, and that even in the treatment of a particular kind or class of slags, as produced by shaft-furnaces for the treatment of argentiferous lead ores, it will not be possible within the limits of this paper to give all of the important data, but simply to briefly state such salient points as have come within the notice and experience of the writer. The subjects discussed will be classified as follows:

I. *Physical Properties*.—(1) Density; (2) crystalline form; (3) color; (4) luster; (5) fluidity; (6) fusibility; (7) magnetism; (8) friability; (9) influence of slow and rapid cooling.

II. *Chemical Properties*.—(1) General composition; (2) modes of decomposition; (3) quantitative analysis; (4) analytical data; (5) types.

PHYSICAL PROPERTIES.

Density.—The specific gravity of slags formed in argentiferous lead smelting has been found to be very variable. The minimum noted was 3.3 and the maximum 4.16; the best slags, however, may be stated to have a density of from 3.4 to 3.65. Iron, barium, and lead cause high specific gravities, while silica, lime, and alumina have a tendency to diminish the weight. The average density of one hundred samples taken daily in 1880, at Leadville, during very fair work, was found to be 3.691. A series of experiments was conducted on this subject for over a year without arriving at any very positive or satisfactory results. It is now believed that difference in density alone can not be used as an infallible guide, but should only be regarded as an auxiliary for a thorough study of slags.

Crystalline Form.—Most slags show some tendency toward crystallization. A few have been noted in which the crystallization was very imperfect, yet the silver and lead losses were small; these, however, were exceptions and not the rule. In general, the more crystalline a slag is, the better it is, considered both from an economical and a metallurgical stand-point.

The center or "heart" of a cooled pot or cone of slag is always found to be the most crystalline; this tendency diminishes outwardly in all directions until next to the surface is a thin crust or scale devoid of a crystalline structure and presenting a thin vitreous or glassy scale. This scale is the result of rapid cooling of the slag as it comes in contact with the iron pot. If the grade of bullion produced is not quite high (say over 300 ounces of silver per ton) and the lead charge is not very low, it is rare to find a very crystalline slag containing more than 1 per cent of lead or more than 2 ounces of silver per ton; generally these markedly crystalline slags show a much smaller loss than this. A very careful study of the crystalline form of lead slags will unquestionably enable a skilled metallurgist to identify the type of slag produced, to tell within reasonably close limits the general composition, and to form a comprehensive idea as to the losses in both lead and silver.

The most important crystalline forms of slags are either large thick plates or leaves; thin plates, often semi-transparent and frequently marked with striae; monoclinic prisms, which may be either inclined or rectangular; several modifications of the cube; delicate needles, which may or may not radiate from a central nucleus; hexagonal plates; and lastly, what may be termed for convenience botryoidal and pectolitic crystallization. These various forms are shown in the accompanying diagrams (Fig. 1). There seems to be a distinct connection or relation between the crystalline form and the chemical composition of these slags, as it will be endeavored to show when the subject of "types" is considered.

Color.—Lead slags are almost always black, or of some dark shade. The darkest slags are those containing the most iron; yet iron will sometimes give either a reddish tint, due to the presence of a small amount of Fe_2O_3 , or have a slight greenish cast. Lime tends to lighten the color, giving the slag a stony or earthy appearance. Manganese in large quantities gives a reddish to amethystine hue, and when the manganese is associated with 20 per cent CaO , and over, the slag very often has a resinous color, closely resembling blende. Zinc, in the presence of alumina, some manganese, and much silica (from 36 to 37 per cent), gives a color very closely resembling porcelain or obsidian; this is especially true of the outer rim of the pot (see analysis No. 82). Lustrous black slags are always due to the presence of much iron. Some exceedingly siliceous slags (from 38 to 42 per cent silica) have a greenish cast.

Luster.—Most of the slags formed in lead smelting are vitreous, although the high lime and also the very high iron slags are not as a rule vitreous. The luster is rarely pearly, often resinous; submetallic, splendid, also pitchy—in short, they possess lusters analogous to those of the unisilicates and bisilicates as formed in nature.

Fluidity.—Thick, viscid slags almost invariably occasion losses in both silver and lead; generally, the more fluid a slag is, the more perfect will be the separation of lead, and consequently that of the silver. When the fluidity is entirely dependent upon iron, there is a liability to iron crusts, and these will then produce great losses. Scientific smelting should aim at obtaining a fluid slag, a slag built up to approach some one of the recognized types. Silica is the chief cause of viscosity in slags, although even a properly calculated slag will sometimes run viscid, owing to a lack of fuel, or soon after starting up or "blowing in" a furnace. During heavy snows or rains, or in exceedingly cold weather, the slag may run viscid because of an insufficiency of fuel.

Manganese increases the fluidity of slags to a marked degree, often rendering even siliceous slags fluid. Lime may or may not make a fluid slag; most high lime slags flow with a smooth oily flow, fluid when hot and either stringy or brittle according to the other ingredients present. Some slags are so fluid and smelt so fast, especially when the ore charge is coarse, that they do not allow a perfect separation of lead and silver; under these circumstances, the furnace is said to "drive too fast."

Fusibility.—Generally, the more fusible slags are, the more economical they are; they require less fuel, drive faster, often prevent "over-fire,"

cause a more perfect separation of the valuable metals, and should be the aim of the lead smelter. Easily fusible slags do not always give rise to very bright tuyeres, although they usually show a light, and the scale or crust immediately in front of the tuyere is quite thin.

Silica lessens the fusibility; manganese and iron always increase it; while magnesia and zinc rarely, if ever, cause a more fusible slag. Alumina may or may not increase the fusibility of lead slags. If the percentage of silica is low, alumina plays the rôle of an acid, and hence increases the fusibility; if, however, the percentage of silica be high, then alumina acts as a base, and hence lowers the fusing-point of slags. This statement has been arrived at after many long and extensive experiments, involving the smelting of many thousand tons of ore. The closer

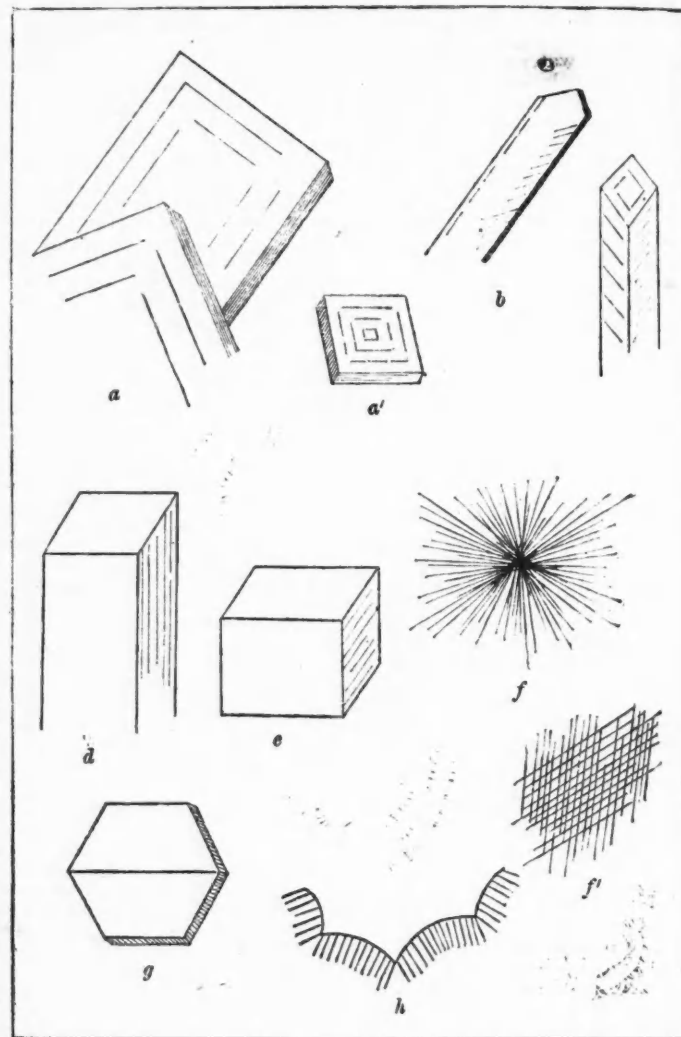


Fig. 1.—Crystalline Forms of Lead Slags.

certain recognized slag types are approached, the greater will be not only the fluidity but also the fusibility. It is, however, not always an economical mode of procedure to adhere too rigidly to any general form of slag.

The subject of the fusibility of slags can not but be regarded as one of the chief points to which the lead smelter should direct attention in the treatment of silver-bearing lead ores by means of the shaft-furnace. Professor Gordon, in his translation of Gruner's *Studies of Blast-Furnace Phenomena*, makes the following valuable remarks: "There is, however, a considerable difference in the temperature required for the complete formation of different slags. According to Plattner's experiments, although the temperature of fusion of the slag itself, when formed, varies much less for different proportions of acid and bases, forming singulo-silicates, bisilicates, and trisilicates, the temperature at which slags are formed varies considerably. In general, singulo-silicates require a higher temperature for formation than bisilicates; and of singulo-silicates, those of alumina form at 2400 degrees C., magnesia form at from 2200 to 2250 degrees C., baryta form at from 2100 to 2200 degrees C., lime form at from 2100 to 2150 degrees C., iron and manganese form at from 1789 to 1832 degrees C.

"The silicates of oxides of manganese and iron (protoxide) differ very little from each other. The bi and trisilicates of the different earths are formed at a lower temperature. Of the bisilicates, those of baryta and lime form at 2100 degrees C., baryta and alumina form at 2050 degrees C., lime and magnesia form at 2000 degrees C., lime and alumina form at from 1918 to 1950 degrees C.

"The temperature required for the formation of compound silicates from the earths composing them is very much higher than that at which slags that have been already fused can be melted. As the slags coming from smelting processes are seldom formed by fusing together these independent components, but more frequently from a mixture of silicates already formed, partly from the ores, etc., and generally of manifold combinations of the oxides of the earths, the temperature required for the formation of the new slag or compound silicates will lie between their

* From *Mineral Resources of the United States for 1884*.

point of fusion and the temperature that would be necessary to form this new slag from the simple substances.

"Refractory slags, which are always indications of faulty working of the furnace, arise either from insufficient temperature or from injudicious combination of the charges—as when too much silica and too little of the bases, or the contrary, are present, or if among the bases there be an excess of alumina and magnesia. Such slags are recognized by their pasty nature, their earthy, half-fused appearance, and by the air-holes pervading them. On the other hand, the charge is a good combination when the slag flows out at a good consistency, as free from metal as possible, and when, for a given consumption of fuel, the maximum of ores can be used."

Dr. Percy, while objecting to the principle of Plattner's method, because it assumes that alloys of gold, silver, and platinum fuse at the mean temperature of the component parts, says we may accept his results as affording practical information of value. "The melting-points of metals and their alloys are fixed and unvarying, except under extraordinary conditions of pressure, and as they extend through a very wide range of temperature, they may be conveniently employed in the determination and comparison of high temperatures." Plattner himself considered that he had only determined temperatures "correctly proportioned to each other, and not absolute thermometric limits."

In this connection, it will be well to quote a few lines from Overman, which, while they are in the main correct, contain one or two statements that are subject to limitations and corrections when viewed from a lead smelter's stand-point. "If," says Overman, "a compound of lime and siliceous melts at 3000 degrees C., that of protoxide of iron and siliceous at 2000 degrees, and that of a silicate of oxide of lead at 1000 degrees, the mean heat of the three, by which they melt when mixed together, is not

$$\frac{3000^\circ + 2000^\circ + 1000^\circ}{3} = 2000^\circ,$$

as their various degrees indicate, but it may be only 1500 degrees, and in this case even lower than that." The above statement is unquestionably correct; then follows this remark: "The greater the number of elements in the slag, the more fusible it becomes; it is, therefore, of the utmost importance in all smelting operations to multiply the kinds of ores; this produces fusible slags and fusible metals." In general, multiple bases do produce a more fusible slag than where only a few bases are present; but there are certain notable exceptions to this rule or law in the cases of zinc, alumina, and magnesia. No intelligent lead smelter would for a moment think of adding zinc simply that there might be a larger number of bases to enter the slag; nor would it be policy to add either alumina or magnesia. For some reason, not as yet very clearly understood, magnesia has been found to increase the silver losses to a remarkable extent. The latter portion of the above-quoted passage in regard to multiplying the different kinds of ores is the proper mode of procedure from other considerations aside from the simple fact of fusibility. Overman also says: "Slags should be as fusible as the metal that is to be smelted with their assistance. If they are more refractory than the metal, the slag causes it to assume a heat by which more or less of it is evaporated." Since lead melts at or about 325 degrees C., the probabilities are, that very few lead slags have this low fusing-point.

While there are a number of substances that will make fluid slags, yet, owing to the cost and the difficulty of procuring them in large quantities, we must therefore of necessity use either iron, lime, or manganese. The proper and economical use of these bases in localities where the ores to be smelted are highly siliceous (and this is generally the case) becomes a matter of either profit or loss in carrying on this industry. The problem, in other words, may be stated thus: How shall we cause the largest amount of silica to be fluxed off into the slag and at the same time use as few costly bases as possible, producing a fusible and clean slag?

Magnetism.—In December, 1879, it was discovered that the slags produced at the old works of the Grant Smelting Company were all magnetic. Thinking that perhaps this might be peculiar to this kind of slag, one hundred and eight samples were collected, including specimens from all the furnaces of the different works at that place, and in every case the same property was observed. The entire mass of some slags was found to be attractable by the use of an ordinary horseshoe magnet. An attempt was made to discover some relation between the intensity of the magnetism and the lead and silver losses; but so far, without obtaining altogether satisfactory results.

Experiments were instituted clearly demonstrating that this magnetic property was not due to fine particles of metallic iron mixed with slag. It was also noted that it was exceedingly rare to find an ore from this locality which is not in part attracted by the magnet, and by panning or concentrating these ores, the black magnetic oxide of iron (Fe_3O_4), so common in placer mines, will be found. It may therefore be said, as a partial explanation, that this magnetic sand passes into the slag giving it this property. It is possible that the reducing power of these furnaces was imperfect, for example, due to a lack of fuel; but the smelters at this time were inclined to use more fuel than has since been found necessary for good work. An oxidation at the tuyeres may also give rise to this phenomenon, as, for example, by using too strong a blast. I have found that even siliceous slags are more or less magnetic; all lead slags containing from 25 to 55 per cent of ferrous oxide and even high lime slags also are magnetic; hence, the chemical composition seems to have little or no effect upon the magnetic property of slags. Of course, if magnetic oxide of iron enters the slag *as such*, it implies necessarily a waste of precious flux; yet I am of the opinion that the magnetic property is due to (1) an unavoidable admixture of some ferric silicate; (2) to the ferrous silicate itself; and (3) in many cases to the presence of iron matte; this is especially true where very impure ores are treated and the production of matte is large. The mineral fayalite is a silicate of protoxide of iron, yet it is attractable by the magnet. I find that iron matte (Fe_2S) is always more or less magnetic; therefore, a part of the magnetic property is often due to this cause. The slags produced at all the prominent smelting-works in this country show more or less a magnetic property, and samples of slag from many of the abandoned dumps have this same characteristic; therefore, I am led to the conclusion that this is a general property of lead slags.

If it can be shown that the magnetism of lead slags is due to sesquioxide of iron, more than nine tenths of all the analyses of lead slags are

incorrect, as it is exceedingly rare to find a slag analysis in which sesquioxide of iron is reported.

Friability.—The friability or brittleness of slags is dependent upon the number, kind, and amount of the bases present. Generally, the more siliceous a slag is, the tougher it is, and the greater the amount of base, the more brittle it is, though the latter statement is subject to certain limitations. Slags not containing over from 33 to 34 per cent of silica are usually brittle; whenever the silica runs up to say 35 to 40 per cent, we have quite tough slags, unless the slag has very little iron and a large amount of lime (say from 22 to 30 per cent). A slag containing 30 per cent SiO_2 , 50 per cent FeO , and from 8 to 9 per cent CaO , is not very brittle, yet the amount of base is large in comparison with the amount of acid present. Slags of the type 30 per cent SiO_2 + 40 per cent FeO + 20 per cent CaO are always brittle; so also are the slags containing 34 per cent SiO_2 + 34 per cent FeO + 24 per cent CaO .

As an example of tough slags, analyses Nos. 18, 32, 36, 40, and 97 may be cited. The following analyses are examples of brittle slags: Nos. 7, 13, 14, 45, 46, 55, 56, 57, 64, 65, 66, and 67. The most brittle slags I have ever seen are those numbered 64, 65, 66, and 67 in the table of analyses. Whenever the amount of matte produced is quite large, it is often best to form a slag that is slightly tough; otherwise, there will be difficulty in obtaining a close saving of the matte. If the ores contain much zinc, this causes the matte cake to adhere closely to the bottom of the slag cone; in this case, it is best not to have the slags too brittle. Generally, the brittle slags are freer from both silver and lead. The brittleness is the result of a highly crystalline structure.

Influence of Slow and Rapid Cooling.—The more slowly a newly drawn pot of slag is cooled, the more perfect will be the crystallization. Such slowly cooled slags have a certain fixed fusing-point, and are generally only imperfectly soluble in any of the strong mineral acids. This slag upon breaking open a pot ordinarily shows a well-defined crystallization when the type is closely approached, and on the outer edge there will be a thin crust or scale of glassy material. If slags are cooled rapidly, the crystallization will be imperfect; and if very rapidly, the structure is entirely changed, and often crystallization is entirely absent. If melted slag is either poured or plunged into water, the crystallization is entirely prevented, and the mass (if not in too large quantities) will show a glassy appearance not unlike that of obsidian. Slags thus rapidly cooled have suffered a very remarkable and hitherto unrecorded change; they will be found to have a much lower fusing-point, and by powdering them, they will be found to be entirely soluble in any of the strong acids, especially in hydrochloric acid. By taking advantage of the last-named fact, it will be readily seen that fusions for the analysis of slags are entirely unnecessary in connection with this industry.

It is generally customary at lead smelting-works to turn a stream of water on the slag trough or "slag runway" soon after tapping a pot of slag, thus chilling and rendering brittle that portion that has adhered to the trough, and this is almost always thrown away, injudiciously so, it is thought, since this portion will not only contain many matte globules, but also very often pellicles of lead that may have lodged upon the trough either from a "blow-pot," or from a leaky breast. This rapidly cooled slag is not only generally richer, therefore, than the main body of the slag, but, if for no other reason, it should be saved for these uses: It melts at a very low temperature, and hence is valuable for "blowing-in" a furnace; to be fed after "barring the hangings;" and it also serves a most admirable purpose in keeping down or preventing the so-called "over-fire" or "fire-tops."

CHEMICAL PROPERTIES.

General Composition.—Lead slags are chiefly silicates of iron and lime; aside from these bases, manganese not infrequently plays an important part, as seen by analyses Nos. 9, 36, 37, 49, and 50. Zinc, alumina, baryta, and magnesia also sometimes enter slags as important constituents; but these bases, when present to any considerable extent, will occasion trouble and are to be avoided if possible.

In argentiferous lead smelting, the slag will always contain some lead and silver; in many cases, these elements only exist in minute traces. From the fuel, the slags derive some potassium and sodium and also phosphorus, but the amount is, however, quite small. Sulphur will always be found; the amount usually varies from 0.5 to 2 per cent. When copper ores enter the smelting mixture, some of this metal will also enter the slag, particularly in re-working the cuprififerous matte. Dr. Wedding reported 0.27 per cent Cu_2O in the Saint Andreasberg slag in one instance, and in another case 0.50 per cent. In an analysis of the Clausthal slag, made in 1870, Hampe reported $\text{NiO} + \text{CoO}$, Cu_2S , and Sb_2S_3 ; the phosphorus was reported as PO_5 . Certain lead slags of Spain were once used as a source of vanadium. At Leadville, at one time, no less than three different mines were yielding vanadium in noticeable quantities. I have known a large ore mixture or "bed" to be smelted that contained no inconsiderable amount of these vanadium ores, and have detected vanadium in ores from the following different Leadville mines: Morning Star, Evening Star, Waterloo, Etna, and especially in ore from the Park mine. The Little Ellen mine, at Red Cliff, Colorado, was also found to contain a green vanadium mineral (supposed to be desclozite). Owing to the above-mentioned facts, I think that vanadium is no uncommon constituent of the Leadville slags.

Aside from the above-mentioned elements, which are chemically combined, I have noted certain abnormal slags containing as a mechanical mixture portions of quartz varying in size from a mere speck to large white, usually rounded, pebbles from 2 to 3 inches in diameter. These pebbles were worked out through the tapping-hole with difficulty, and when broken showed a dull, white color, resembling that of unplazed porcelain. Then again I have noticed sesquioxide of iron, sometimes in pieces an inch large; also pieces of quicklime; this, however, has only been observed when the furnace was being "blown out." In one instance, quite a large piece (a quarter of an inch in length) of sulphide of zinc was found, which was highly crystallized; this occurred at the very bottom of a cone of slag after breaking off the matte cake.

Before passing from this subject, it may be well to mention that, by closely observing the very top of a pot of slag, there will very often be found in blistered cavities exceedingly delicate needles; sometimes these crystals will appear almost white, then again of a yellowish tint (this is supposed to be due to oxide of zinc), and again others of a dis-

tinctly bluish tint. These bluish crystals have been found to contain both sulphur and lead, and are perhaps a subsulphide. These delicate crystals I have most frequently seen when the production of matte was large, although one of my metallurgical friends informs me that he also has noticed these crystals when scarcely any matte was formed. Shot-like globules of metallic lead have been observed in certain highly siliceous slags. Whenever the production of iron matte is unusually large, it is not an uncommon thing to find rounded globules of it in the slag; this is particularly the case on the very outer rim of the pot.

Modes of Decomposition.—The ordinary method of fusing slags with carbonate and nitrate of soda in a platinum crucible will sometimes give good results; but since the slag always contains more or less lead, it will be readily seen that the analyst runs the risk of either injuring or completely spoiling the platinum crucible by the reduction of metallic lead. A very good method of proceeding when the samples are not taken according to the method to be subsequently described is to powder the slag well in an agate mortar, then digest with strong hydrochloric acid, evaporate once to complete dryness upon the water-bath; then add more hydrochloric acid, filter, and fuse (or, better, agglomerate, or semi-fuse) the residue with sodium carbonate in a platinum crucible, and proceed as usual according to the well-known method for the determination of insoluble silicates.

The above mode of procedure is found somewhat long for the practical uses in connection with industrial works, where time is a great desideratum. To facilitate the fusion, and also to prevent the liability of destroying costly platinum crucibles, I have for a long time used a method of fusing the slag in a silver crucible with caustic potash and then proceeding as usual in the analysis. The method last described has the advantage that the heat required for the fusion is quite small, in fact, an ordinary alcohol-lamp is found sufficient; and as many laboratories connected with the lead smelting-works have neither gas nor the improved gasoline burners, the method is therefore very serviceable. The disadvantage is, that the silver crucible is always slightly attacked by the caustic alkali, and when a complete analysis is to be performed, the silver gives trouble in some of the determinations. This difficulty is, however, entirely overcome if a platinum crucible is heavily plated with gold, as has been suggested by W. Bettel in the *Chemical News*.

A method that I will now describe has been used for several years in connection with these works, and leaves little to be desired. If in taking the laboratory sample we use an ordinary steel bar, throw aside the crust from a newly drawn pot of slag, dip the reversed end of the bar about two inches into the molten slag, then quickly plunge into a bucket of water, and use this sample for analytical determinations, it will be found that all slags made in lead smelting will be entirely decomposed by strong hydrochloric acid, giving rise to perfectly pure gelatinous silica. By using a small amount of acid, and with a little practice, one can determine the silica, iron, and lime contained in a slag in less than two hours.

Quantitative Analysis.—After taking the slag sample, as previously indicated, weigh out from half a gram to one gram, transfer to a covered casserole, add from the wash-bottle a few drops of water, stir well, and add concentrated hydrochloric acid; again stir, and digest over a free flame for a few minutes. The addition of water and the stirring prevent the slag from clotting or caking upon the bottom of the vessel. Now add a few drops of nitric acid, both to insure the oxidation of the iron and also to decompose the few particles of lead sulphide that are apt to form during the first addition of hydrochloric acid, and rise upon the sides of the vessel. Sometimes these black specks are due to carbon, which will, of course, be burned off in the ignition of the silica. Evaporate to dryness upon the water-bath; this is not a long operation, if the analyst uses a minimum quantity of acid (say 6 to 8 c. c.). After the evaporation is completed, add a few drops of water, just sufficient to moisten the mass, and evaporate a second time. Now add a slight excess of concentrated hydrochloric acid; warm, dilute, and filter, washing the silica with boiling water, and drop a small amount of hydrochloric acid around the edges of the paper; wash again with water. The moist residue, with the paper, is transferred directly to either a porcelain or a platinum crucible, placed in an ordinary scorification cup, and dried before the assay muffle until the paper begins to carbonize. It is then placed in the muffle for about five minutes, removed, and allowed to cool, and the silica is then weighed. The silica will be found perfectly white, not even tinted with iron, and the determination is as accurate as if a fusion had been performed.

For the determination of the iron, it is advisable to take a second portion of half a gram, boil with hydrochloric acid to complete decomposition in a casserole, then dilute with water and add a small piece of unamalgamated zinc directly into the covered vessel. After a few minutes, the cover is removed, washed, and the contents of the casserole are cautiously transferred by decantation to a large beaker, and diluted with water up to 500 c. c.; now add rather a large amount of concentrated sulphuric acid (say 25 c. c.), and titrate the iron with a standard solution of potassium permanganate.

It will be noted that it is entirely unnecessary to remove the silica in order to determine the iron, and furthermore, time is saved by reducing the iron by unamalgamated zinc directly in the vessel in which the decomposition of the slag is effected. For commercial work, a solution of permanganate is made by dissolving 5.686 grams of the salt in one liter of water.

For the estimation of lime, two methods are used, according to the degree of accuracy to be attained. If, for quick work, we wish to ascertain the percentage of lime, we use the filtrate from the silica as follows: Heat this filtrate, add ammonia to a slight alkaline reaction, then add a saturated solution of oxalic acid to dissolve the iron; boil for a few minutes, allow to stand twenty-five minutes, filter hot, wash well, and transfer to a casserole; add some hot water and sufficient hydrochloric acid to dissolve the calcium oxalate, filter, and dilute with cold water. Now add rather a large amount of sulphuric acid, heat to boiling, and titrate with the same solution of permanganate as was used in the iron determination. If a greater degree of accuracy is desired, the iron and alumina are removed as basic acetates, then the manganese is separated by bromine water, the zinc removed by sulphureted hydrogen, and the filtrate treated according to the usual methods for estimating the lime.

Some manganese will invariably pass into the filtrate when the iron

is precipitated by ammonia, and will come down with the lime, thus introducing an error to the extent of its presence. When, however, the amount of manganese is small in comparison with the amount of iron, we can often use the first-mentioned method with a great saving of time.

For the determination of the manganese, from one to two grams of the finely divided slag is used, according to the amount present; this is treated in a casserole with concentrated hydrochloric acid, with the addition of a small amount of nitric acid, in order to convert all the iron into the ferric form. Now boil, and add sulphuric acid, gradually replacing all of the nitric acid, and also hydrochloric acid; the success of the operation depends upon the entire removal of the hydrochloric acid. Dilute to about 150 c. c. and boil; add an emulsion of zinc oxide in large excess, by which the iron is precipitated as ferric hydrate; filter off the silica and oxides of zinc and iron, and dilute to 500 c. c. Some writers recommend, before the addition of zinc oxide, neutralizing with sodium carbonate, and then clearing the solution with a few drops of nitric acid; this in practice is found to be unnecessary. Draw off from the diluted liquid, after thorough mixing, an aliquot part (say 100 c. c.), transfer to a casserole, heat to boiling, and titrate with frequent stirring with the same permanganate as was used for the iron and lime until the first rose tint is observed. Calculate the percentage of iron corresponding to the permanganate used, and multiply this percentage by 0.2946 (= per cent Mn). The manganese scheme, as above stated, is highly recommended, both for its rapidity and accuracy; in fact, there is no known method that I think will compare with it for technical and scientific work.

The sulphur is determined by the "Fahlberg-Iles" method as follows: Fuse one to two grams of finely divided slag in a silver crucible (or gold-lined platinum crucible) with twenty-five grams potassic hydrate for twenty minutes; cool, dissolve in water, filter off the hydrated oxides of iron, etc.; now add 30 c. c. bromine water, and then concentrated hydrochloric acid to an acid reaction; boil off excess of bromine, filter, if necessary, add barium chloride, and proceed as usual for the treatment of barium sulphate.

If other constituents are to be determined, the methods are followed as given by Fresenius, Rose, Sutton, Cairns, or Hart.

(TO BE CONTINUED.)

BESSEMERIZING OF COPPER MATTES.

On former occasions, we have drawn attention, says *Engineering*, to the treatment of copper mattes in converters, similar to the Bessemer converters, as practiced by M. Manhès at works in France, and introduced by him in several places in other countries. Up to a comparatively recent date, M. Manhès was using only vertical converters for working the mattes, the main difference between them and the regular Bessemer converters consisting in the position of the blast-nozzles, which were not placed in the bottom as usual, but in the sides, some little distance from the bottom. The reason for this was, that, when the concentration of a matte was carried so far that metallic copper separated and sank to the bottom, the metal was rapidly chilled by the passage of the blast, and eventually left in the converter. This was avoided by placing the nozzles at some distance from the bottom, and it was possible to convert rich matte wholly into copper, and still retain the metal in a liquid form necessary for its removal from the converter. But, even with this arrangement, it was not found practicable to convert a low-grade matte directly at one operation into copper, because the amount of slag produced was so large. It was found better to blow for a time, concentrating the matte, and then to pour out the rich matte and slag into pots, let them separate, and finish the conversion of the matte into copper in another separate operation. This of course caused delay and increased expense, and M. Manhès has endeavored to overcome this objection by a totally new form of converter, which shall render quite practicable the direct conversion into copper, at one operation, of mattes containing only 20 per cent of copper. The converter in question consists of a cylindrical vessel of sheet-iron, suitably lined with refractory material, placed with its long diameter horizontal, and arranged to turn on rollers like a Danks puddling-furnace or other furnace of that type. A wind-pipe runs along one side of the casing, from which blast can be blown in through some twenty nozzles passing through the lining of the furnace. There is a neck on the opposite side of the furnace from the nozzles, through which the gases escape during the blow, and through which the liquid contents of the converter can be discharged at the close of the operation. The two ends of the converter have openings in them, which can be closed as required, and which serve for the observation of the process, for the introduction of any requisite fluxes, and chiefly for the removal of slag at any stage during the operation. This converter is not intended to revolve during work. It is made to turn on rollers, so that the blast nozzles may be at any moment brought below the surface of the matte, or raised above it in a perfectly easy manner. By means of this furnace, or converter, it is easy to regulate the process so that the slag formed is kept at a proper consistency and can be removed rapidly without interrupting the work or necessitating a change from one converter to another.

Another Miner's Lamp.—At the recent conference of the Miners' Union, Mr. Burt, M.P., the president, observed that a very desirable thing was the provision of a good, useful light. An electric lamp for the miner's personal use was an admirable thing. They had one before them, which was self-contained, and consisted of a battery composed of three cells, each 6 inches high by 3 inches wide and 1 inch deep. Each cell consisted of a charge of chloride of silver and two thin zinc plates, a weak solution of caustic potash being added. The current produced supplied a small glow-lamp, of German manufacture, placed in front of the metallic case containing the battery, after the fashion of the bull's-eye of a police lantern. The light by this lamp was stated to be of 3 candle-power, and to be capable of burning for nine hours; but this, as far as candle-power goes, is in excess of the requirement of the miner, so that smaller sizes are made. One of these is circular in form, 3 inches in diameter, 3 inches deep, and of 2 candle-power, and will burn for five hours.

A NEW METHOD OF LAYING SUBMARINE TUNNELS AND TUBES.*

By Richard P. Rothwell.

The device to which I desire to call the attention of the members of the Institute consists of a water-tight caisson, which is connected by a stuffing-box with the tube to be laid, and the caisson is pushed forward with hydraulic jacks set against the end of the tube. The tube is of hard white iron, cast in chills in segments. These segments are carried from shore through the tube itself, in which a track is laid as the work progresses, and the segments are bolted together in the caisson, where there is ample room to work and proper appliances for handling heavy weights. As each segment is bolted on, the jacks are set against its forward end, and when the whole ring is complete, the caisson is pushed forward by the jacks, a trench having been dredged out in front of it. or, in very loose ground, jets of water under a heavy pressure can be thrown out to loosen the ground in front of the caisson. The direction in which the caisson is pushed is completely under control, and both the caisson and the tube are loaded to the amount necessary to overcome their buoyancy.

I understand that negotiations are now under way for the construction of a 16-foot tunnel of this kind across the Straits of Northumberland, between Prince Edward Island and the main-land, and for tunnels in several other places. One of the most interesting uses of this system is in laying water mains out into lakes. The work can be carried on without interruption from storms, etc.; and when the desired distance has been reached, the caisson can be converted into a filter, which can be easily cleaned from time to time.

The accompanying illustrations show the general design of this novel

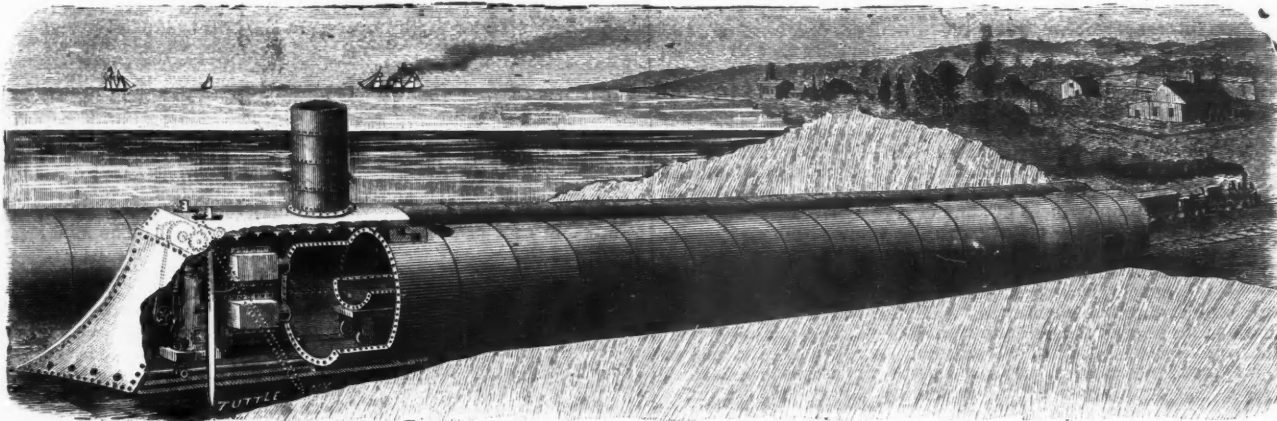
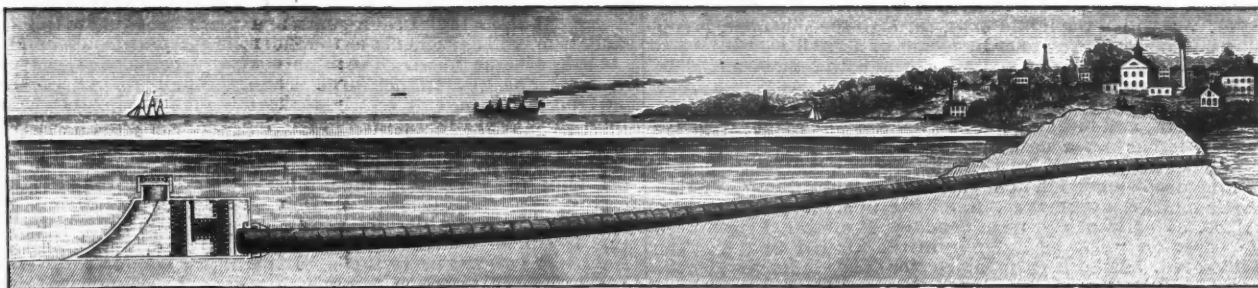
four hoistways, a pumpway, and a manway. When the sinking-frame had been pushed a sufficient distance down from the permanent lining, the jacks were lowered a few at a time, and an additional timber of the lining was slipped in and formed a new base from which to push with the jacks.

From the experience in that case, as well as from the simplicity of the problem, it appears to me possible to apply this new method of tunnel-laying without serious difficulty, and with great economy where the local conditions are favorable. And there are many cases where the question of grade, the nature of the bottom, and other conditions render the construction of a tunnel in the ordinary way impracticable or enormously expensive. This new system offers such striking advantages in such cases, as well as for laying water-pipes out into lakes, that it can not fail to interest engineers, and in that expectation I have brought it before the Institute at this time.

ON THE TRANSMISSION OF ENERGY.*

By L. Lossier.

The experiments conducted by Marcel Deprez, whatever else they may show, have incontestably proved that, even to small distances and under most favorable circumstances, the transmission of energy by electrical means is considerably dearer than the production on the spot by usual methods. The cost of transmitting by electricity power from Belle-garde to Lyons, a distance of 123 kilometers (76 miles), would under present conditions cost at least ten times that obtained by burning coal on the spot, and it is not likely that any improvement in the future can



A NEW METHOD OF LAYING SUBMARINE TUNNELS AND TUBES.

and ingenious method of laying tubes, both for railroad and water-work purposes. Full particulars and estimates are furnished by the patentee, Mr. H. H. Hall, No. 95 Liberty street, New York; but without entering into these details, which necessarily vary with the local conditions, it is evident that a tunnel of this kind could in most cases be laid at a small part of the cost of an ordinary tunnel. The iron segments may be cast at the furnace, and would therefore cost little more than pig-iron, and the operation of putting the segments together is simple and inexpensive. The tube would generally be lined with a concrete or beton lining, which would help to load it and would protect the iron from the effect of corroding gases. White cast-iron is very slightly acted upon by sea-water.

My own professional interest in this improvement was first engaged by the fact that I had devised a somewhat similar contrivance for sinking a shaft in Pennsylvania about fifteen years ago. I used a solid sinking-frame of 12-inch timbers, with a bevel iron shoe on the bottom, and into this sinking-frame a number of hydraulic jacks were let, so that when the ram was down the head of the jack rose only a little above the top of the frame. The sinking-frame was pushed down, as the gravel and clay were removed, by jacking from the permanent lining of the shaft, which was also composed of 12-inch timbers. Heavy plate iron bolted to the outside of the sinking-frame lapped over at least two timbers of the permanent lining, and being pressed tightly against these, prevented the gravel, sand, etc., from entering the shaft between the sinking-frame and the shaft-lining.

This method of sinking was found extremely convenient, and the movement of the sinking-frame was under perfect control, and the parties who used it found no drawback to it, though the frame was 75 feet long over all and 12 or 13 feet wide, the shaft being intended to have

reduce this cost 90 per cent, in order to compete with the latter. The author proceeds to discuss the transmission of power by transportable apparatus, for example, accumulators. If it were possible to separate the peroxide of lead from the two electrodes, and transport it in a charged state, the question of transmission would be solved, because the materials would always possess the same intrinsic value, and the cost of accumulated energy would alone be required; but unfortunately this is impossible; and the extra dead weight is so large that the cost of its transport becomes excessive. Sodium, however, might be used as a magazine for transportable energy, as it is universally abundant, and as a source of electricity could be applied with the highest efficiency for the production of mechanical power. At the present moment, there are two objections to its employment—the one, the high price of sodium; the other, the non-existence of any practical sodium battery. The latter objection is not discussed, because the question is now under treatment by several eminent electricians, and though no complete solution has yet been attained, the time is probably not far distant when it will be.

As regards the former, the author first establishes by calculations detailed in the paper that, in order to compete with coal in the production of motive power, sodium must not cost more than from 10 to 11 centimes per kilogram (say 4d. a pound), and then proceeds to discuss the cost of manufacturing sodium by the electrolysis of common salt.

Preliminary experiments, not very complete, however, and on a small scale, in which the electrolysis of salt maintained in igneous fusion gave off at the cathode sodium in its vaporous state, which was subsequently reduced by cooling to its solid form, furnish data from which it is calculated, that, if large quantities are manufactured, using water-power

* A paper read at the Pittsburg Meeting of the American Institute of Mining Engineers, February, 1886.

* Abstract of a paper in *L'Electricien*, vol. ix., 1885, page 629. From the Minutes of the Proceedings of the Institution of Civil Engineers of London, edited by James Forrest, Secretary.

as the prime motor; and an electrical current is used of such intensity as to maintain the salt in fusion without the application of heat from other sources, the price of sodium could be reduced to 24.5 centimes per kilogram (say 1¹/₂ d. a pound). It must not be forthwith assumed that sodium can be manufactured at this price; but this figure is what the author obtains from his own experiments, which can readily be repeated by any one interested in the subject.

MODERN AMERICAN METHODS OF COPPER SMELTING.*

By Edward D. Peters, Jr., M.E., M.D.

CHAPTER XII.

COPPER REFINING.

The gradual cessation of ebullition and the rapid formation of oxide of copper by no means indicate the entire disappearance of the sulphur present, which, from its strong affinity to copper, remains dissolved in the bath with great tenacity. If the oxidizing process has been sufficiently thorough to insure the presence in the liquid metal of a perceptible quantity of suboxide of copper (from 0.2 to 0.7 per cent according to different authorities), a small sample ingot poured at this stage will exhibit a very peculiar and characteristic phenomenon. On cooling, it will suddenly rise in a line along the center, often forming an abrupt ridge several lines in height, and having an irregular and granular fracture. This is said to be due to the absorption of sulphurous acid, a property only possessed by metal containing a considerable proportion of suboxide of copper, but still unrefined and tenaciously holding on to a trace of sulphur and other impurities. The process of "flapping" or "rabbling" is now begun, by which the liquid bath, through the side door, is constantly agitated in a peculiar manner by means of a small rabble.

It is, of course, a pure oxidizing operation, and both tedious and slow, requiring, on an average, two hours of constant work. Although seemingly a most awkward and ineffectual means of agitating an extensive bath of molten metal, and bringing all its particles in contact with the atmospheric air, it has never been improved upon. The copper now becomes "dry," from the dissolved suboxide, and when poured into a mold, sets with a deep depression upon its surface, while its fracture has a characteristic mottled appearance, following upon a previous fine-grained surface, as particularly mentioned by Professor Egleston in his valuable paper on "Copper Refining in the United States." The color is a brick-red, but both grain and color are so influenced by the temperature at which the metal is poured, as well as by the rate of cooling as determined by the size of the test-ingot, that these signs must always be taken in conjunction with other and more reliable indications. The metal during this period is undergoing a powerful scorification from the dissolved oxide of copper, and most injurious impurities are gradually oxidized, and either effectually removed by slagging or volatilization. Certain metalloids, however, resist this scorifying influence to a remarkable degree, and consequently have a most injurious effect upon the refined metal. These are arsenic, antimony, and tellurium, mentioned in the order of their harmfulness. The extreme importance of the subject warrants the mentioning of the best means to remove the two first-mentioned impurities, the latter having come but once within the author's experience, and probably requiring the employment of one of the electric or chemical methods, by which excellent copper can be made from very poor material.

A careful trial of Vivian's invention of dry-sweating, by which the impure blister copper is exposed to a long oxidizing heating just below the fusion-point, has not succeeded with the writer; but the addition of from 3 to 5 per cent of pure white metal—subsulphide of copper—to the bath at the beginning of the refining process (as suggested by some person forgotten by the author) has a most rapid and satisfactory effect in removing both arsenic and antimony. Very bad cases may require two such additions, with an intervening oxidizing operation. A still more sure and radical method consists in exposing the arsenical ore to a dead roast, and subsequently smelting the same with a large proportion of raw iron pyrites—cupriferous, if possible. The resulting low-grade matte should be regarded and treated as a sulphide ore, and will, if the initial calcination is thoroughly conducted, be free from either arsenic or antimony.†

The process of reduction follows that of oxidation, and the suboxide of copper having served its purpose as a purifying agent, must now be reduced to metal again; otherwise, the copper would be brittle both when cold or at higher temperatures and unfit for manufacturing purposes. The reduction is effected by means of a long pole, as large as can be introduced into the furnace and of any kind of green wood—hard wood being the most economical. This being buried in the metal bath, evolves an immense volume of hydrocarbons and other reducing gases, and rapidly removes the excess of oxygen. The surface of the metal is also covered with charcoal, to prevent access of air, and samples are constantly taken to determine the condition of the copper. The entire removal of all the oxygen present is impossible, even overpoled copper, according to Egleston, containing over 0.1 per cent of oxygen. An otherwise tough copper may become brittle from overpoling, and this is doubtless due to the fact that the impurities that were present in the tough copper were dissolved as oxides and consequently innocuous, but on being reduced to the metallic state, at once asserted their deleterious influence.

The poling usually lasts an hour or more, and is continued until a full-sized test ingot shows no contraction or depression on cooling, and the texture is extremely fibrous and silky, and of a beautiful rose-red. Further tests are made by nicking and bending test bars, and by ham-

mering out a piece into a thin plate, which should show no cracks at the edge. This condition of tough-pitch is essential to copper used for rolling or wire-drawing, but is entirely superfluous for ingot copper that is to be used for brass founding; as it may be easily imagined that the fusion that it undergoes in the brass-founder's crucible under various oxidizing and reducing influences effectually upsets the exquisite niceties of the refining process, so far as the proportion of dissolved suboxide is concerned.

A volume could be easily filled with practical comments upon the process of refining, but space forbids any further details. The addition of lead to copper intended for rolling is quite common in England, and is doubtless beneficial with many impure coppers. The purer copper of the Lake District and from the Arizona carbonates does not seem to receive any benefit from this practice.

The molds used for the casting of ingots should always be made of copper, and are easily and rapidly produced by the ordinary ingot stamp, as illustrated in Egleston's paper. The proper taper of the mold and the proportion of surface in contact with the ingot have an important effect upon the ease with which the mold delivers. When the copper is ladled too hot, the molds are rapidly ruined, and should be returned to the refining-furnace as fast as they become in the least imperfect. Otherwise, constant annoyance and accidents will result from the obstinate sticking of the ingots.

The ladles used in the refining process come almost exclusively from England, and are made of a peculiar quality of iron. They last from 10 to 100 operations, according to the temperature of the copper and the care bestowed upon them.

The Ansonia Brass and Copper Company has patented a new mold for casting ingots directly from the furnace, without the intervening process of ladling. While such an improvement would relieve the workmen from the most hot and laborious portion of the operation, the very nature of the metal, its high fusion-point and great heat-conducting capacity, cause it to chill so suddenly as to render the success of such an invention a matter of some doubt. The same company employs a gas generator for heating a single refining-furnace, and although pronounced convenient and successful, it can hardly make any great saving, considering the small amount of fuel generally used in ordinary refining, and the great expense of the generator plant.

A great saving in the expense of refining has already been made by increasing the capacity of the ordinary furnace, and the next important improvement may be looked for in improving the quality of the refined copper and increasing its strength and tenacity. How this is to be effected is far too important a subject to be discussed within the limits of a practical paper on existing methods. Experiments conducted by Mr. Patch, of the Detroit Copper Company, as well as the writer's personal trials, seem to indicate that the presence of suboxide of copper is by no means essential to the greatest malleability and strength, as believed by Percy, and that a proper method of treatment may result in the production of copper having a strength far beyond the best brands at present known.

CHAPTER XIII.

TREATMENT OF GOLD AND SILVER-BEARING COPPER ORES.

A very few words may serve to indicate the present practice in the separation of the precious metals from copper. The older processes employed for this purpose were by far the most complicated and wasteful operations known to metallurgy, and it is only since the discovery and introduction of the various "wet" processes that any but the richest coppers could be advantageously treated for the precious metals.

The Ziervogel process has only been successful in a few isolated cases, and demands such pure material and such skill in manipulation as to debar its use in ordinary instances, nor does it provide for the extraction of gold.

It is indisputable that the electrolytic methods are rapidly advancing to the front in the treatment of gold and silver-bearing metallic copper, and have the great advantages of producing a copper of the best quality, but are yet largely in the experimental stage, and require a bulky and expensive plant.

The new Hunt & Douglas method, as applied to copper ores or mattes, seems to fill the gap more completely than any previous invention. By this method, the copper is extracted from the ore or matte after a very imperfect roasting, and being precipitated as a disulphide by sulphurous acid generated from pyrites, it is decomposed by about one half its weight of metallic iron, the resulting cement being fit for immediate refining. The copper is obtained in a state of absolute purity even in the presence of arsenic and antimony, while the residues containing every trace of the gold, silver, and lead originally present may be smelted with lead ores in a blast-furnace. The process has long passed the experimental stage, and offers advantages peculiar to itself and unshared by any other.

The ease with which the small amount of gold, sometimes present in cupriferous pyrites, may be won is not realized by all copper smelters, although the method is extensively practiced in this country, as well as at Swansea and in Chili.

Owing to its great affinity for metallic copper, the gold contained in white metal may be concentrated into a very small bulk of the former by exposing the pigs of matte to a slow, oxidizing fusion, exactly as in the process for making blister copper. The operation, however, is interrupted as soon as a certain quantity of metallic copper is formed, when the furnace is tapped, and the product—now advanced to *pimple metal*, or even *regule*, from 82 to 88 per cent—being examined, *bottoms* of metallic copper will be found under the first few pigs. This is the method pursued in making *best selected* copper; for not only does the small quantity of metallic copper extract the gold, but also the greater part of other foreign and injurious substances—such as arsenic, antimony, tellurium, tin, etc. The proportion of *bottoms* formed must vary with the quantity of gold present; in some instances, even a repetition of the processes being required to fully extract the more valuable metal. Silver is but slightly concentrated by this operation, as will be

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† The author is unable to give the original source of many statements here made and tested by himself with satisfaction, and desires to distinctly disclaim any originality in any operation or apparatus pertaining to copper metallurgy; having always preferred to adopt those improvements that have been thoroughly tested by others of a more original turn of mind.

observed from the following assays made under the author's direction—want of space forbidding fuller details of this important process :

Assay of original white metal.			Proportion of bottoms formed.	Assay of bottoms		Proportion thus extracted.		Assay of residual pimple metal.	
Gold.	Silver.	Per cent.		Gold.	Silver.	Gold.	Silver.	Gold.	Silver.
Ounces.	Ounces.	Per cent.	Ounces.	Ounces.	Per cent.	Per cent.	Ounces.	Ounces.	
0.64	93.3	6.4	9.60	213.4	93.7	14.8	0.030	78.7	
2.37	16.6	9.0	19.10	36.2	90.2	18.5	0.110	14.2	
0.11	....	5.4	1.73	....	88.4	.....	0.012	....

In examining this table, it must be remembered that a considerable concentration has taken place in the matte itself as well as in the copper bottoms, so that the results do not seem to agree ; but the figures given are sufficient to indicate the general results of the process. Unless the furnace bottom is already well saturated with auriferous metal, a heavy loss in gold must be expected.

CHAPTER XIV.

THE BESSEMERIZING OF COPPER MATTES.*

While the reader must be referred to Prof. Egleston's pamphlet, as well as to the literature of the future, for all details pertaining to this new and interesting innovation, the present treatise would be incomplete without a few remarks upon a process which promises to become of great importance when introduced where the conditions are suitable for its application. So many new and valuable improvements have been greatly injured and retarded by their miscellaneous and improper application, that a few words of advice from one who witnessed the construction and starting of the first successful American copper Bessemerizing plant may be of value. While there is no doubt of the technical success of the process as perfected by M. Manhès, and constructed in this country under the direction of his pupils, it is only under certain conditions that its real usefulness can assert itself, and any attempt to apply it to all and every variety of circumstances would certainly result disastrously.

The Bessemerizing plant, as constructed at the works of the Parrot Silver and Copper Company at Butte City, and observed by the writer at its commencement, was adapted to two different duties: 1st. To receiving copper matte of a low grade—from 15 to 40 per cent—and bringing it up to white metal—75 per cent; or, 2d. To bringing white metal up to a very pure blister copper.

The impossibility of producing metallic copper from poor matte at one continuous operation is quite evident, as, aside from the difficulty of dealing with the great quantity of slag formed from the iron and other foreign bases contained in the low-grade matte, the amount of metallic copper produced therefrom would be too small for manipulation. For instance, the usual charge—2000 pounds of a 20 per cent matte—would yield less than 400 pounds of blister copper, a quantity far too small to submit to any blowing operation in a converter.

This is especially the case in M. Manhès's converter, where the tuyere orifices are situated at some distance above the bottom of the vessel. This latter peculiarity has been found an essential element of success; for, whereas in iron, the whole contents of the converter are homogeneous, the blast traversing the entire mass of metal, and oxidizing the impurities, which may be regarded as distributed equally throughout the molten iron, so that the whole product gradually becomes pure without any division into a finished and still uncompleted portion—in treating copper matte above 75 or 80 per cent, the liquid metal that until that point has been homogeneous throughout must then begin to separate into two portions—namely, sulphide of copper and metallic copper that has been deprived of its sulphur by oxidation. As the process continues, the latter product augments in quantity, while the former decreases, until the last atom of sulphur is removed. Were the tuyeres at the bottom of the converter, the metallic copper would soon chill and obstruct them, and it was not until M. Manhès raised them to such a height as to allow the quiet subsidence of the metallic product below their inlets, that he attained complete success. It is necessary, however, that a sufficient amount of copper be present to support the superincumbent layer of liquid matte above the tuyere openings, so that the blast may traverse a molten and oxidizable product to the last, and thus generate sufficient heat to maintain the entire mass in a liquid condition.

Experience has shown that upon introducing a matte containing from 72 to 75 per cent of copper into the converter, the process advances with great rapidity and completeness, while a matte of 60 or 65 per cent requires several times as long for its oxidation. On the other hand, a low-grade matte of even 15 or 20 per cent advances with satisfactory speed to the condition of white metal—from 70 to 75 per cent—and there stops or continues very slowly. The practice has, therefore, been adopted of interrupting the oxidation of the low-grade matte at the point indicated, pouring out of the converter, that it may separate from the slag, and subsequently completing the process in a second vessel, the products of two or more "blowings" of poor matte being united to form a single charge for blister copper.

It is, therefore, necessary for economy to have two sets of converters, and while three converters are required for a single operation, five, or possibly four, converters are sufficient for the complete process. A converter will usually stand from eighteen to twenty-four blows (twenty-four hours) without repairs, so that for the single operation, one converter is undergoing repairs, the second is drying, while the third is in use.

In France, a separate cupola is used for melting the matte for the converter; but the Parrot Company has found it feasible to run the matte directly from the ore blast-furnace to the converter.

No fuel is required to keep up the temperature in the converter while

working on low-grade matte; but the operation for blister copper requires the occasional use of a few pounds of coke to keep up the necessary high temperature.

While the construction of the converter plant is simple, the management of the same requires much care and experience.*

The appearance of the flame issuing from the mouth of the vessel is of little value as a guide, owing to its changeable color from the various foreign constituents of the matte. The tuyeres require constant opening with an iron rod, taking one man's whole time.

The lining of the boiler-iron converter is of crushed quartz (or pure siliceous sand) mixed with enough plastic fire-clay to hold it together. It is rammed in large balls, the original shape and size of the interior vessel being obtained from an oil-barrel, used as a core, about which the lining is rammed. The same material is used for repairs. A cylinder blowing-engine supplies the blast, which is much less powerful than in ordinary Bessemer work, the height of the liquid column of metal being only a few inches, and the entire charge not exceeding 2200 pounds.

Any attempt at estimating the saving effected by this operation under any given circumstances would be futile, as the process, although satisfactory to its owners, and thoroughly successful in the opinion of the author—speaking as a spectator—is still under constant improvement, and when stripped of its crudities and adapted to American conditions, will give very different results from those obtained at its first introduction.

There is every reason to believe that its capacity will be greatly increased, and as even in its present state it can show a great saving in fuel and labor above any of the older methods, there is little doubt that it will, ere long, be recognized as an essential feature of every large copper plant, except where very cheap fuel or other peculiar conditions neutralize its advantages. The elimination of arsenic and antimony by this operation was highly satisfactory, as far as the author's observations extended.

Whether an undue loss of silver by volatilization may also occur in argentiferous mattes, yet remains to be decided. The slags from the Bessemerizing of low-grade mattes form a welcome basic flux in the ore-furnace, while the lining of the converter is partially protected from their corrosive influence by the feeding of pulverized siliceous ores through the tuyere-holes with the blast.

Since writing the above, the positive assurance is received that the Manhès process has obtained a firm foothold at the Parrot Company's works, having been greatly improved and modified to suit American circumstances. Its capacity has also been greatly increased.

It would be impossible to furnish any exact estimates of cost under existing conditions; but it is stated that the expense of producing high-grade blister copper from matte by the new method is less than one half of the former cost. (THE END.)

Calorimetrical Studies on the Effects of Sudden Cooling and Hardening on Molten Steel.—By — Osmond, in *Beiblätter zu Wiedemann's Annalen der Physik und Chemie*, 1885, page 569: abstracted in the Minutes of the Proceedings of the Institution of Civil Engineers of London: The author dissolved different steels in solutions of copper chloride and ammonium chloride, and determined the relative production of reaction heat.

	Percentage of Carbon.	Made soft.	Hardened.	Suddenly cooled.
Soft steel.....	0.1700	1.000	1.405	.....
Medium steel.....	0.5400	1.000	1.045	1.052
Hard steel.....	1.1700	1.000	1.065	1.084
White cast-iron from Sweden	4.1000	1.000	.....	1.050

The hardening being either by sudden cooling, or by otherwise treating, increases the reaction heat. From this, the author concludes that there are two modifications of iron—the one, crystalline, is formed by slow cooling; the other, amorphous, by quick cooling, etc.; but these particular modifications only occur when carbon is present. Copper similarly treated does not show any difference in reaction heat in either the hard or soft modifications.

BOOKS RECEIVED.

- (In sending books for notice, will publishers, for their own sake and for that of book-buyers, give the retail price!)
- Electro-Deposition.* A Practical Treatise on the Electrolysis of Gold, Silver, Copper, Nickel, and other Metals, and Alloys. With Descriptions of Voltaic Batteries, Magneto and Dynamo-Electric Machines, Thermopiles, and of the Materials used in Every Department of the Art. And Several Chapters on Electro-Metallurgy. By Alexander Watt, author of "Electro-Metallurgy." "The Art of Soap-Making," "The Art of Leather Manufacture," etc. With numerous Illustrations. London: Crosby Lockwood & Co. 1886. Crown 8vo, pages xvi+568 (including Index). 12s. 6d.
 - Household Manuals, Vol. II. Food Materials and their Adulterations.* By Ellen H. Richards, Instructor in Sanitary Chemistry in the Massachusetts Institute of Technology, Author of "Chemistry of Cooking and Cleaning." Boston: Estes & Lauriat. 1886. 12mo, pages 183 including Index and Bibliography). 75 cents.
 - Tables for Calculating the Cubic Contents of Excavations and Embankments, by an Improved Method of Diagonals and Side Triangles.* By John R. Hudson, C. E. Second Edition, Revised and Enlarged. New York: John Wiley & Sons. 1886. 8vo, pages [4]+79. \$1.

PATENTS GRANTED BY THE UNITED STATES PATENT-OFFICE.

GRANTED FEBRUARY 23D.

- 336,590. Process of Granulating Molten Metal. Daniel J. Riker, Montclair, New Jersey Assignor to Samuel Crump same place.
- 336,691. Ore-Grinding Pan. Julius A. Bidwell, Ivanpah, Cal.
- 336,692. Attachment for Amalgamating Pans. Julius A. Bidwell, Ivanpah, Cal.
- 336,703. Attachment for Rod-Rolling Mill. Andrew J. Day, Pittsburg, Pa., Assignor to himself and William F. Thompson, Cleveland, Ohio.
- 336,749. Blast-Furnace Appliance. William Rothoff, Pittsburg, Pa.
- 336,792. Process of Separating Precious Metals from Speiss. St. George T. Bryan, University of Virginia, Va.
- 336,840. Feed Mechanism for Stone-Sawing Machines. Francis H. Cook, Rutland, Vt.

* The Parrot Company's plant was erected and is still managed by pupils of M. Manhès.

* See *School of Mines Quarterly* for May, 1885, for paper on this subject, by T. Egleston.

FURNACE, MILL, AND FACTORY.

The Union Steel Company, Chicago, Ill., is making extensive repairs and alterations, preparatory to resuming operations at an early day. Among other improvements, McClure & Co., furnace builders, of Pittsburg, have erected for it two regenerating gas furnaces under Hainsworth's patent for heating ingots vertically. Each furnace will heat four ingots at once, 14 inches square by 5 feet in length.

A terrific powder mill explosion took place on the 1st inst., at Goes station, Ohio, where the dry-house of the Miami Powder Mills was blown to atoms, and three men who were working in and near the building were torn into fragments. The company has been unfortunate as far as accidents are concerned. On the 2d of February, as mentioned in the JOURNAL at the time, three powder-mills at the same place were blown to atoms.

The National Tube-Works Company, of McKeesport, Pa., has been sued by Gotlieb E. Fritz, for \$10,000, for the death of his son Julius, aged thirteen years, who was killed while in the employ of the company.

Advices from Youngstown, Ohio, state that the Lowell furnace has blown in after being banked two weeks for lack of coal. The Thomas furnace at Niles is receiving some coke, and was to blow in this week. Tod furnace has been relieved, and will blow in soon. The Sharon and Hubbard furnaces are again running. Should there be no difficulty in securing coke, all the furnaces in the valley that were banked for want of coke will be in operation again.

Morris, Tasker & Co.'s iron foundry at New Castle, Del., is offered for sale.

Orders have been issued to prepare the Glendon Iron Company's No. 4 furnace in South Easton, Pa., for blast. The stack has been idle for several years.

The Bethlehem Iron Company's No. 6 furnace, Easton, Pa., will be put in blast soon. This company now has nearly all its furnaces in operation.

Hussey, Howe & Co., of Pittsburg, Pa., have begun making steel in their new 20 ton open-hearth furnace, which they have just completed.

The Dickson Manufacturing Company, of Scranton, Pa., reports that it has just shipped a fine blowing-engine to the Chateaugay Iron and Ore Company, Plattsburg, New York; one to the New Jersey Iron and Zinc Company; a fine compound pumping-engine to the South Bethlehem Water-Works, Bethlehem, Pa.; and another to the Bowling Green (Ky) Water-Works.

The sale of the Otis furnace plant and property at Mancelona, Mich., has been completed. The purchasers were Messrs. H. J. Hollister, J. M. Barnett, N. F. Avery, and T. J. O'Brien, of Grand Rapids; H. R. Durkee, of Chicago; and E. W. Andrews, of Cincinnati. Active operations have already begun to work the property to its full capacity of forty tons of pig-iron a day.

The American Pulverizing Company has been incorporated in New York City by Willard M. Fuller, Richard N. Dyer, John C. Tomlinson, and H. W. Seeley. The object is to rend and reduce rock. The capital is \$300,000.

The Worcester, Mass., Malleable Iron Company, of which E. P. Howe is President, C. H. Bowker Secretary and Treasurer, has made an assignment to Samuel Woodward.

Proposals will be received until March 20th by C. G. Force, City Civil Engineer, Cleveland, Ohio, for the construction of the iron superstructure and iron trestle-work for an elevated roadway or bridge at Cleveland. The total length of the iron structure will be about 3930 feet; width, 57 feet; and the height will vary from 30 to 100 feet.

The Western Malleable and Gray Iron Company, of Port Washington, Wis., has been incorporated with the object of manufacturing castings and iron and wood articles of all kinds; the incorporators are H. W. Lyman, J. W. Vail, and W. H. Landolt; the capital stock is \$50,000.

The Keystone Powder Company, Limited, has been organized at Reading, Pa., with Samuel Barrett as President; George W. Bard, Secretary and Treasurer; Theodore M. Hauser, Superintendent. The capital is \$20,000. The works are located in a ravine near the Schuylkill River, about four miles from Hamburg. The company expects to export dynamite, and the works will be enlarged as the demand increases.

The Board of Water Commissioners of Little Falls, N. Y., have asked for proposals until March 18th for

furnishing salt-glazed clay water-pipe and specials in quantities, estimated as follows: 10,000 lineal feet of 20-inch pipe, 18,400 lineal feet of 18-inch, 1200 lineal feet of 15-inch, 1000 lineal feet of 12-inch pipe.

The Braddock Wire-Works Company has been organized. William Edenborn, of St. Louis, was elected President, William H. Rowe Secretary and Treasurer, and Lieut. Thomas W. Fitch Superintendent. The works are to be built at Braddock, and will be for the manufacture of barbed wire.

LABOR AND WAGES.

The employes of the Warren Foundry and Machine Company, in Phillipsburg, New Jersey, have been notified that their wages will be advanced 15 per cent on March 15th.

The Amalgamated Association of Iron and Steel Workers proposes to establish in Pittsburg, Pa., a large depot or store, "from which will be distributed supplies of flour, groceries, boots and shoes, tobacco, etc., to subordinate stores throughout the manufacturing communities of the country."

The nail plate feeders of Pittsburg and vicinity have formed a permanent organization. It was decided to stand firm for a 21-cent scale, regardless of any compromise scale accepted by the nailers.

The burners of the stone quarries in the Desplains Valley, Ill., met at Chicago last week, fixing the scale of wages at the prices for which the men struck last year, which is \$1.25 a day for March, \$1.50 for April, and \$1.75 for the rest of the season. The scale that caused the strike last year was \$1, \$1.25, and \$1.50 for March, April, and the season respectively. The men are satisfied, and work will begin when the season is inaugurated.

The nail mill of the North Chicago Rolling-Mill Company, at Bay View, Wis., which has been closed for the greater part of eight months on account of a difference between the nailers and manufacturers as to wages, resumed operations on the 1st inst. The union men who went out on June 1st, last year, will go back to their old places. The scale of prices has been fixed on what is known as the "Mingo basis."

At a meeting of the Bituminous Coal Exchange, held at Philadelphia, Pa., on the 1st inst., to consider the question of an advance of wages in the Clearfield and mountain regions, it was decided not to advance wages, since the present price of coal did not warrant it.

Almost all the principal trades unions at Chicago, Ill., have pronounced for eight hours' work and eight hours' pay, beginning May 1st.

The employes at the Ashley shops, Wilkes-Barre, Pa., of the Philadelphia & Reading Railroad, have been notified that the company has restored the rate of wages paid prior to January 1st, 1885. The reduction then was eight per cent.

The Spaulding Iron Company, of Brilliant, Ohio, has withdrawn from the Western Nail Association and signed the compromise scale that was signed by the Junction Iron Company, of Wheeling, West Va., last week. The scale is the same as that signed by the Junction, so far as the rate for cutting nails is concerned; but for heating, 67½ cents per ton is to be paid, coal furnaces being used. The Junction scale was 63 cents per ton, gas furnaces being used.

The operators requested to meet the executive committee of the National Federation of Miners and Mine Laborers for District No. 3 at Cumberland, Md., on March 1st, to discuss the question of an advance, have refused to do so, and this is considered as a challenge for a fight. District No. 3 comprises the mining regions known as Clearfield, Irwin, Myersdale, and Garrett, Pa.; George's Creek, Md.; Elk Garden, West Va.; and Pocahontas, Va. The men in the Myersdale region have already been granted the advance, and are not included in the order to strike.

TRANSPORTATION NOTES.

The construction of a railroad from Leadville to Aspen, Colorado, is about assured.

The Tennessee Coal, Iron, and Railroad Company's report for February shows coal received directly from mines, 10,587 tons, and coke, 13,045 tons; total for 1886, coal, 20,292 tons; coke, 23,932 tons.

The Southern Pacific Railroad Company has issued a freight rate of 37½ cents per 100 pounds for all classes of freight from San Francisco to Missouri points and Chicago.

The January statement of the Philadelphia & Read-

ing Railroad shows an increase in gross earnings of \$278,788, an increase in expenses of \$215,258, an increase in net earnings of \$63,530. The company carried 794,123 tons of coal as compared with 668,637 tons during January, 1885.

It is reported from Kansas that there is no doubt that the Atchison, Topeka & Santa Fé Railroad will build its "connecting link" between Lawrence and Atchison. This will insure to that road through its leased line, the Kansas Southern, connection with Southern Kansas from Atchison. When this is completed, it is said that the company contemplates building from Thayer to Columbus, tapping the coal-fields of Cherokee and Columbus counties.

The Cheyenne & Northern Railroad Company has been incorporated with a capital of \$3,000,000, divided into 30,000 shares. The line of the road is from Cheyenne north to Fort Laramie, thence northwest to Fort Fetterman and through Johnson County to Montana, thence northwest to the Northern Pacific.

The annual report of the Pennsylvania Railroad Company shows that the gross earnings of all the lines owned or controlled by the company during the year amounted to \$92,994,548.94; the gross expenses, including rentals, etc., to \$61,690,901; leaving \$31,303,647.94 in net earnings. The freight traffic for the year aggregated 86,872,570 tons.

COAL TRADE NOTES.

ILLINOIS.

The Co-operative Coal Company, at Bloomington, on the 3d inst., struck a four-foot vein of coal at a depth of 289 feet. The shaft was started some months ago, by dissatisfied miners who left the employ of mining operators. They were aided by one or two farmers, on whose land the shaft was sunk west of the city. They had spent \$15,000 and blasted through fifty feet of rock before striking the vein. The coal is said to be of good quality.

The Laurel Hill Coal Mining Company has been incorporated at Belleville, to carry on a general mining business; incorporators, John Beard, William E. Tolmie, and Daniel Green.

PENNSYLVANIA.

ANTHRACITE.

The jury in the Deringer-Coxe land case rendered a verdict for the defendants on the 27th ult. The plaintiff will ask for another special trial on the remaining four tracts of land yet in dispute, containing some 1700 acres, and Calhoun M. Deringer will also appeal to the Supreme Court from the verdict rendered, on the ground that Judge Hand committed an error in rejecting some of the county books and public records that were important evidence. In the next case, the plaintiffs will ask for a change of venue.

The Black Diamond Colliery, which has been idle since the first of the year, has been leased by Hollenbeck, of Audenreid, and Hannum, of Pottsville, who will at once sink a new slope and enlarge the breaker.

A fire was discovered on the 3d inst. in the second level of the Mineral Railroad and Mining Company's Hickory Ridge slope, Shamokin. The loss can not be estimated. The miners all escaped in safety.

COKE.

J. W. Moore will build 350 more ovens at his works, in the Pleasant Unity District. When these are completed, the works will then number 550 ovens.

GAS AND OIL NOTES.

Exports of refined, crude, and naphtha from the following ports, from January 1st to February 27th:

	1886.	1885.
	Gallons.	Gallons.
From Boston.....	456,136	909,559
Philadelphia.....	14,939,335	9,763,573
Baltimore.....	1,948,800	1,188,420
Perth Amboy.....	350,944	.....
New York.....	59,466,380	53,020,082
Total exports	77,161,595	64,971,094

COLORADO.

The Arkansas Valley Oil and Land Company has struck a well on its lease near Florence, Tremont County, which, it is thought, will produce fifteen barrels a day, this being by far the best well struck in this district. The company has begun drilling on its

No. 6 well. The refinery is now ready to fill all orders promptly.

MARYLAND.

The Cumberland Oil and Natural Gas Company decided, at a meeting held in Cumberland, to begin operations at once. A call of \$5 a share will be made payable April 1st, and bids will be asked for the boring.

NEW MEXICO.

A report states that an artesian flow of crude petroleum had been discovered in the southern part of Santa Fé County, between the mining villages of Golden and Wallace. The oil flows through tubing 55 feet down, and the flow is copious and steady. The crude oil burns freely and with a bright flame.

PENNSYLVANIA.

A charter has been issued to the United Gas Fuel Company, of Pittsburg and Alleghany, with a capital of \$10,000.

A large tract of land near Armagh, nine miles this side of Johnstown, has been leased by the Philadelphia Company, where a test well will be put down.

The Manufacturers' Natural Gas Company has decided to begin laying its line to Pittsburg at once. The gas will be brought there from the Cowden well, sixteen miles from the city.

The People's Gas Company is pushing its arrangements for perfecting its supply system, and among other late movements is leasing lots for its gas-holders, used for the purpose of regulating the pressure upon the pipes. It is said to be the policy of the company to push its system as rapidly as possible.

Harrisburg parties have within a few days purchased over 600 shares of stock in the Washington Natural Gas Company (J. B. Ford's). The company is paying 1 per cent regular monthly dividend.

GENERAL MINING NEWS.

A suit brought by Major James M. Selover against Ashbury Harpending to recover \$17,331.32 lost in a speculation in State Line mining stock, Nos. 2 and 3, in August, 1881, was on trial before Judge Sedgwick, in the Superior Court, New York City, on the 3d inst. Major Selover alleged that a verbal contract was made between Mr. Harpending and himself, by which they were to divide the profits equally, if there should be any, but that Mr. Harpending should bear all the loss himself. The loss was the amount stated. Mr. Harpending denied the contract, and made a counter claim for \$3360, the value of 3200 shares of the stock lent to Major Selover. The jury gave a verdict for the plaintiff for \$18,600.

ARIZONA.

COCHISE COUNTY—TOMBSTONE DISTRICT.

Many of the mines are now idle, waiting for developments below the water-level.

CONTENTION.—Prospecting is going on in the different levels.

GRAND CENTRAL.—Forty tons of ore are milled daily from the upper levels.

GROUND HOG.—In sinking a new working-shaft, a strike was made near the surface, one half of the shaft being in ore.

MAMIE.—About forty tons of ore are shipped monthly to Pueblo, Colo.

UNCLE SAM.—A strike has been made, the ore of which, by assays made, shows a large percentage of gold.

PIMA COUNTY—QUIJOTOA DISTRICT.

There is a great deal of dissatisfaction openly expressed on the street, says the San Francisco *News-Letter*, at the management of the Peer and Peerless mines at Quijotoa. It is difficult to arrive at the real cause of the tremendous depreciation in these stocks, reports from the mines are so contradictory. Some changes at the front might be beneficial all around.

ARKANSAS.

It is reported that Col. E. R. Moffit, of Joplin, Mo., is so favorably impressed with the exhibits thus far made in the recent mineral discoveries in the vicinity of Bear Mountain, as mentioned in our issue of February 6th, that he contemplates the erection of reduction-works for the treatment of the ores. The ore in the territory referred to is probably not so rich, says the *Age of Steel*, as that of some of the older mining districts. At any rate, the discoveries thus far made do not warrant a more flattering conclusion. But this disadvantage, it is said, is more than counterbalanced by the ease with which the ore can be mined, together with the exhaustless supply of it. In the northwestern

part of Arkansas, the occurrence of rich manganiferous ores has already been proved beyond dispute, and large capital has been invested in the discoveries by Pennsylvania and St. Louis capitalists and manufacturers. A blast-furnace in St. Louis will probably be put in operation for the smelting of these ores thirty to sixty days hence, provided through shipments from the mines can be had by rail by that time.

CALIFORNIA.

INYO COUNTY.

The architect of the Sharon gateway for Golden Gate Park at San Francisco has decided to recommend Inyo marble to be used in its construction. An analysis of stone taken from the Inyo quarry gives the following statement as the result: From a geological stand-point, it is not marble, but dolomite, and contains considerable magnesia, which will enable it to resist the chlorine gas that is found in the atmosphere of the sea. This makes it specially desirable for the Sharon gateway, which will be at all times subjected to the sea breeze. This marble will prove magnificent for building and art purposes. It is perfectly adapted to sculpture, being a trifle softer than Italian marble, and having no line of cleavage to interfere with fine work.

MONO COUNTY—BODIE DISTRICT.

Reports for the week ended February 22d:

BODIE TUNNEL.—The face of the north drift on the 200-level west ledge is looking well and producing ore sufficient to keep the mill running full-time. Ore delivered to mill, 277 tons.

STANDARD CONSOLIDATED.—The average of ore-bodies continues without special change. Ore sent to mill, 381 tons. Bullion shipment will be made on the 23d. The mill is running steadily.

NEVADA COUNTY.

CROWN POINT.—The work of reopening the 300 level, which is 120 feet below the level that is now furnishing quartz for the mill, is progressing. No work has been done on this level since 1871, and it is found that the shaft contains much mud and slime that have to be removed. As soon as this is done, exploration will begin. The ore taken from the 180 level averages about \$25 a ton.

PLUMAS COUNTY.

CROWN POINT.—Work has been resumed. A tunnel has been started, and it is to be run at nearly right angles to those formerly run on that property. The course of this tunnel bears to the north center of the Ophir Consolidated. The arrangement that permits this work is important, as by it both mines can be operated successfully together.

PREMIUM.—The five-stamp mill is now in operation. Ore is extracted from the mine, and crushing will be continued as long as there is a supply of water sufficient.

ROUND VALLEY CONSOLIDATED.—The ledge has been reached, after running the tunnel about 350 feet from the place of beginning, making the entire length about 800 feet. The ore prospects well, and it is claimed that it will pay a good milling profit.

YUBA COUNTY.

Complaints have been made on the affidavits of the Anti-Débris Association's watchman, and papers have been served on the Eureka Lake and Blue Tent Hydraulic mining companies, and on W. H. Wiseman, who is alleged to have been working the Blue Tent claim, citing them to appear before the Superior Court of Yuba County on March 8th next, and show cause why they should not be punished for contempt in violating the injunction of the court, which prohibits the working of the mines by the hydraulic process. There are two complaints against the Blue Tent Company.

CANADA.

PROVINCE OF ONTARIO.

ALGOMA MINES COMPANY.—This company was organized for the purpose of working some mining property lying about thirty-five miles east of Port Arthur, where it owns several valuable mining claims, all situated on a tract of 400 acres of land owned by the company. A shaft has been sunk to a depth of 182 feet.

CROWN POINT.—This mine, which is about a quarter of a mile north of the east end of Silver Mountain, has been sold to an American company, which will shortly begin to work it, and put up a stamp-mill to treat the ore.

NORTH SHORE MINING AND PROSPECTING COMPANY.—This company has been organized with a capital of \$20,000, for the purpose of purchasing mining options

on the claims in the Thunder Bay District, and developing and placing them on the market.

COLORADO.

CLEAR CREEK COUNTY.

COLORADO CENTRAL.—The large 200 horse-power air-compressor for this mine is getting into position. It is duplex build, and was manufactured in New Jersey. All the machinery in connection with the Colorado Central will receive motive power from this compressor, including drills, pumps, etc., doing away with steam power, water being substituted.

CORRY MILLING COMPANY.—It is reported that the personal effects of this company at Georgetown were sold at sheriff's sale on the 24th ult., at a sacrifice, on an execution in favor of R. J. Buchanan, of Denver. The entire lot, consisting of ore-sacks, barrels, wheelbarrow, etc., brought the sum of \$79.70.

EGAN CONCENTRATION-WORKS.—These works are overhauling and additional machinery going in. The mill will be run on custom ores.

MARYLAND.—A scheme is on foot to drive this tunnel several hundred feet farther into Saxon Mountain, for the purpose of opening up a number of lodes.

SNOWDRIFT.—The different lessees are all meeting with success in their work, most of the ore produced being high grade.

GARFIELD COUNTY.

D. D. MALLORY.—The shaft has been worked constantly, and a large body of iron has been encountered and has lasted 20 feet without showing signs of diminishing. A drift was run in six feet, also without finding the sides.

GILPIN COUNTY.

NEWFOUNDLAND.—The company has extended its lower east level some 405 feet east of the main shaft, and has opened a block of ground something over 200 feet in length, the mill-dirt averaging over six ounces gold per cord.

SEARLE.—The foreclosure sale of this mine, consisting of 2000 feet of patented property, situated in Russell District, was to take place on the 25th ult., at Central City, to satisfy the sum of \$12,023 and costs of sale, with interest at the rate of 10 per cent a year. The sale is in favor of William Gunn, trustee, against the Searle Mining Company, Limited.

LAKE COUNTY.

The *Leadville Herald* reports the following:

The smelters, which on the first of January were running from thirteen to fourteen furnaces, and were short of all classes of ore, now have sixteen and seventeen furnaces in blast and 50,000 tons of ore on hand.

ANTIOCH.—The mill is running steadily on ore produced from this gold mine.

CASTLE VIEW.—Shipments of ore have begun.

FOREPAUGH.—The lower workings are draining off water, and shipments of ore will probably be resumed soon.

IRON HILL CONSOLIDATED.—The Ines shaft is producing considerable ore. The mineral is of medium grade in silver and lead.

LEADVILLE CONSOLIDATED.—A force of twenty-five men is employed, and considerable new work is doing in addition to the extraction of ore. The output for February will reach about 100 tons of ore. It is thought that the month's work will yield a good profit.

LEE BASIN.—It is the intention of this company, which is also working the Denver City mine, to start up the Wright shaft before March 18th.

LEO.—This shaft, which has been sunk near Oro City, has struck ore. The shaft was started nearly two years ago, and sunk to a depth of 540 feet, where it encountered limestone. The lime rock showed in only a portion of the shaft, while the southern half continued in porphyry. A station cut was made near the bottom of the shaft, and a drift run to the north-westward. This drift showed the ore strike, above referred to. The ore was first discovered in the bottom of the drift, but has since been rising, and at present the floor of the drift shows ore for quite a distance, with eighteen inches in the breast. The ore consists of zinc-blende, galena, and traces of copper and antimony. This shaft has opened up a hitherto comparatively unknown portion of the Leadville District.

LITTLE PITTSBURG.—Some important new exploration work is contemplated.

LOUISVILLE.—It is stated that the existing shaft does not fully meet the requirements of the present extended workings. A new shaft will probably be started early in the spring.

MATCHLESS.—Exploration-work will soon be com-

menced in the northern portion of this mine, on Fryer Hill.

QUINCY.—The old Brittenstine Silver Mining Company, whose property was sold at sheriff's sale a few years ago, has been reorganized under the name of the Quincy Mining Company, and is floated on the St. Louis market. The company is capitalized at \$3,000,000, divided into 300,000 shares, which are represented to be worth about \$1.50 a share, being at the rate of \$450,000 for the property. The cost of the property to the St. Louis syndicate has been less than \$20,000. There is one suit affecting the title to the whole property pending in the United States Court. The property consists of eight or ten prospects. About \$35,000 have been expended in developments, and about \$4000 worth of ore shipped. The veins are mostly small and incased in hard granite, rendering the mining very expensive. The ore is pockety, and mostly low grade. Some marvelously high assays have been obtained, but the rich ore is exceedingly scarce. The present prospectus is a verbatim copy of the report made by George Daly, in 1880, and those most familiar with the property pronounce his statements notorious exaggerations.

SIERRA NEVADA.—A shaft will be sunk on this mine on Iron Hill.

ST. KEVIN.—The new No. 7 Cameron pump, which has been placed in the bottom of the shaft, is draining the mine of the water. The main shaft at present has a depth of 240 feet, showing a fine vein. Levels from the bottom show the rich ore-chimneys to continue downward in undiminished strength, and an increase in the amount of concentrating ore. The property has recently made some fair shipments of ore to Leadville, and is accumulating mineral.

WOLFE TONE.—This mine will make no shipments, and will for the present direct its efforts almost exclusively to development-work. The reasons assigned for this course are the unsatisfactory rates offered by the smelters for the ore production of the mine.

PITKIN COUNTY.

CONNEMARA.—This mine, it is thought, has opened into the main ore-body, but the matter is kept very quiet, owing to the Apex controversy.

EMMA.—The mine has been closed down. The cause of this movement is a difference of opinion among the owners, as mentioned in our last issue.

HUMMING BIRD.—The shaft is now 102 feet deep.

SAN JACINTO.—In this property, a seven-foot vein has been struck at a depth of 110 feet, which has a pay-streak eighteen inches wide. The general character of the vein-matter is similar to that found at other points along the contact, but a peculiar feature of it is a streak of sand lying near the foot-wall. A test on this sand returned 194 ounces per ton. Drifts have begun on the vein.

OURAY COUNTY.

FLORENCE.—This mining and milling company has a portion of its machinery in place, and only awaits the arrival and setting up of jigs before beginning operations.

SAN JUAN COUNTY.

GREAT EASTERN.—This mine, in Burns Gulch, on Jones Mountain, has been sold for \$75,000.

MOLUS.—O. P. Posey has sold one eighth of this mine to General Crawford, of Pittsburg, Pa., for \$5000.

SUMMIT COUNTY.

BIG PITTSBURG.—This mine, on Gibson Hill, has recently been provided with machinery. Twenty tons of assorted ore are mined daily, and arrangements are making to mine forty tons every twenty-four hours. Ten stamps of the Breckenridge mill have been rented, and a contract to treat part of the ore has been closed with the Nashold mill.

NASHOLD.—This mill, which is employing the Wiswell pulverizer and amalgamator, is in successful operation. The Lucky mine will deliver a quantity of ore soon, which will undoubtedly pay to treat. The Standard, Gold Dust, and Big Pittsburg are all hauling large quantities of ore to this mill, which will be treated at the rate of twenty tons a day.

TIP TOP.—This mine, on Gibson Hill, is showing up a gold vein of free-milling ore. From a shaft 100 feet on a working level, a quantity of rich ore is taken.

DAKOTA.

LAWRENCE COUNTY.

CALEDONIA.—The production for the first half of January, bar No. 52, netted \$10,223.28. Advices

dated February 22d state that drift on the 300-foot level advanced 14 feet, making a total of 94 feet. The winze advanced 5 feet; total, 51 feet. The south drift advanced 8 feet; total, 55 feet. Ore produced from 425 feet level, 991 tons; ore produced from cave, 430 tons; total, 1421 tons.

FAR WEST.—A strike has been made, and in consequence the stock went up to 17 cents.

FATHER DE SMET.—Official reports, dated February 22d, show that the ore extracted from the first, second, and third levels was 2075 tons. East cross-cut, third level, advanced 8 feet on company account. Total length, 62 feet.

IRON HILL.—Three more bricks have been produced. The stock is selling at \$2.

LIBERTY.—At a meeting recently held, a committee previously appointed to examine the Costello mill at Lead City made its report, which was adverse to the purchase of the property. The secretary was then instructed to negotiate with Eastern parties for the purchase of new machinery, hoisting-works, etc., so that work may be pushed with vigor.

GEORGIA.

LUMPKIN COUNTY.

J. B. Thomas & Co. are pushing the prospecting on the Martin lot with flattering results, and have struck a very large vein on the north side of the mountain, in the soft belt, and also an encouraging prospect on the south side of the ridge in the black belt.

HAND.—Rebuilding and general repairs have begun at this mine, which has been lying dormant for several years, and it is thought will be in working order in early spring.

LOCKHART.—Tribute work continues at this mine sufficiently to keep the mill on full-time.

ILLINOIS.

JO DAVIESS COUNTY.

A vein of lead ore has been struck near Galena, which promises to be one of the richest ever discovered in this region. The ore is pure galena.

MEXICO.

The Mexican *Financier* reports: The State of Hidalgo has, in addition to its two per cent tax on silver ore for export, placed heavy taxes on the beneficiating haciendas. It is stated that the object of the two per cent tax, as far as regards ore, was to keep the ore in the State for reduction at home.

DOS AMERICAS.—At this Zacatecas mine, the ore, antimonial silver, is yielding handsomely.

SAN AGUSTIN.—This Zacatecas mine has cut its carbonate silver lode, which assays 394 marks, or \$3252, to the ton of 2000 pounds.

SANTA GERTRUDIS.—Rich ore has been struck in the eastern part of the mine, and also in the winze that they were sinking below the level.

MICHIGAN.

COPPER MINES.

TAMARACK.—Ground is reported to have been broken at this mine for No. 2 shaft, which will be about 500 feet west of the present shaft. It is the intention to sink a No. 3 shaft in the near future which will be again 500 feet west of No. 2.

GOLD MINES.

ROPES.—The drift east, in the fourth level, is in 100 feet, showing 10 feet of quartz in width. In the fifth level, the drift is in 30 feet, the lode showing a width of 4 feet, the rock being of excellent quality. This property is said to be in a promising condition of development.

IRON MINES.

FOREST CITY.—The parties who have been for some time exploring the iron ore on this property, situated between the Cleveland hematite and Lillie mines, near Negaunee, have struck what promises to prove a large deposit of brown hematite ore, similar to that of the Cleveland hematite mine. A shaft is down 40 feet. A suitable hoisting-plant and other machinery will be put up with the view of developing the property.

NANAIMO.—From seventy to seventy-five tons of ore a day are mined, this being all taken from the new find, as the old workings are filled with water. All the ore taken out is consumed by the new furnace, to which it is conveyed directly over a long trestle reaching from the shaft of the mine to the furnace stack.

MINNESOTA.

Reports from the Vermilion Lake region regarding the new iron ore discoveries show that test-pits have been sunk in large numbers on the different claims, and the vein shown up. The deposit is a hard, red specular

ore, of very fine grain, and resembles very strongly the ore taken from the Breitung mine at Tower, which ore has averaged sixty-seven per cent metallic iron. According to the *Tower Press*, the vein where seen was ten feet wide at about twelve feet below the surface. The vein runs across the Pattison and Conan tracts, and also across some other lands, showing the same encouraging outlook all along. The only developments that have yet been made are on the Harvey claim, and these are only of the crudest.

MONTANA.

DEER LODGE COUNTY.

WEST GRANITE MOUNTAIN.—This company has been incorporated with a capital stock of \$5,000,000, 500,000 shares, \$10 a share, for the purpose of working the Alameda, Rattlesnake, and Fraction and other lodes, situated near Phillipsburg, adjoining the celebrated Granite Mountain mine. The incorporators are Thomas Cruse, A. M. Holter, H. M. Parthen, T. J. Lowry, E. Zimmerman, C. K. Wells, George Hill, of Helena; J. W. Buskett, of Wickes; Samuel Word, of Butte. Mr. J. K. Pardee has been made general manager and superintendent of the company. The company proposes to begin active operations in a short time. That part of the capital stock set aside for actual working purposes is subscribed for at \$1 a share.

SILVER BOW COUNTY.

ALICE.—The new double-deck cages have been put in place, and are working in a satisfactory manner. This will enable the management to double the quantity of ore at present raised from the mine. There are several new Ingersoll drilling-machines lately purchased for the use of this mine, three of them having been put in the 700 and 800-foot levels.

ANACONDA.—The main shaft of this mine is down 1000 feet, and cross-cutting to the ledge is carried on at the 900 and 1000-foot levels.

LEXINGTON.—The main shaft is now 920 feet deep, and will be sunk to the 1000-foot station in about two weeks. When that depth is reached, cross-cuts will be run to the vein.

NEVADA.

ESMERALDA COUNTY.

FARRINGTON MINES, LIMITED.—This company, which has a capital of £300,000, 150,000 shares of £2 each, has placed upon the London market £60,000 10 per cent mortgage debentures of £20 each. The property consists of nine gold and silver mines, also of the five-stamp mill, situated about eleven miles from Carson & Colorado Railroad—the Belle, Atherton, Iron Horse, Great Western, Lancashire, Manchester, Bolton, Abe Lincoln, and Lapanta—none of which is well known in this country, and none of which apparently affords any basis for either the \$1,500,000 of stock or the \$300,000 of bonds. On the face, it appears to be another example of how very small a foundation the English promoters require for the floating of a gigantic capital. We trust the disgusted stockholders, when they realize the actual value of their property, will blame the English promoters and not the American vendors.

HOLMES.—Every thing at the mill and mine is in good order and doing good work. On the 14th ult., thirteen bars were shipped, valued at \$11,753.49.

MOUNT DIABLO.—Work continues satisfactorily on the different levels.

STOREY COUNTY—COMSTOCK LODE.

From reports of the *Virginia City Chronicle*, we make the following:

BEST & BELCHER AND GOULD & CURRY.—The water in the Osbiston joint shaft was lowered 23 feet during the week ended February 20th. Total number of feet lowered since starting the pumps, 223.

BULLION.—The company has decided to drain the Ward shaft and sink to the 3000 level. The Alpha and Exchequer companies will jointly contribute toward the project. A south drift will be run into their ground from the 3000 level, to prospect the belt of mineralized quartz uncovered on the 600 and 900 levels.

CONSOLIDATED CALIFORNIA & VIRGINIA.—During the week ended the 20th ult., 1125 tons of ore were shipped to the Morgan mill and 1760 tons to the Eureka mill. The average value of ore milled during the week, according to assays from battery samples, was \$13.80 a ton for that crushed at the Morgan mill, and \$16.81 a ton for that crushed at the Eureka mill. Bullion valued at \$58,929.54 was shipped to the office in San Francisco during the week.

HALE & NORCROSS.—The extraction of ore from

the uprise on the vein above the 3000 level has been resumed. A project for placing the mine on a self-sustaining basis is under consideration, and will be made public in due time.

MONTE CRISTO.—The extraction of ore has been suspended, and the east shaft sunk last fall is cleaning out preparatory to starting a west drift from the 150 level. This is a greater depth than the mine has been prospected at heretofore, the ore extracted having been drifted out near the surface. The vein is nearly 30 feet in width, and an improvement in grade may be reasonably anticipated by tapping it at a greater depth.

WHITTIER DREDGE BULLION COMPANY.—This company has been incorporated with a capital stock of \$1,000,000, divided into 100,000 shares of \$10 each; term of existence, fifty years. The trustees are Dr. Julio H. Rae, A. C. Whittier, and F. M. Huffaker. The enterprise is backed by Boston capitalists. The principal object is to dredge the bed of the Carson River to the bed-rock, to raise the quicksilver and amalgam deposited there, and to this end the company has located the bed of the river for a distance of eighteen miles. It will begin the construction of its dredging apparatus immediately. Two dredging-scows will be built, each 100 feet long, with a breadth of from 25 to 35 feet. They will be flat-bottomed, with sharp bows and square sterns, and will draw from 8 to 10 inches of water with the dredging machinery and other appliances on board.

NEW MEXICO.

GRANT COUNTY.

OLD MAN.—This mine at Fleming is now working, and taking out ore at a greater depth than any previously attained in the mine. A depth of five hundred feet from the apex of the vein has been reached.

SIERRA COUNTY.

SIERRA GRANDE.—It is reported that the works at Lake Valley are running successfully.

NORTH CAROLINA.

CATAWBA COUNTY.

SHUFORD.—Prospecting is to begin again. The property was worked for a long time with profit as a placer, but the pond has filled up from the settlements of the often used water, and the supply has been lost. The indications point to veins rich in precious metal, and it is for these that search is to be made.

ROWAN COUNTY.

QUEEN OF ROWAN.—Some development-work is carried on at this property, which consists of 120 acres of land. The vein where cut is 18 inches wide. The ore carries free gold in quantities often visible to the natural eye, and a small percentage of sulphurets. It is quite probable that machinery will be erected during the present season.

PENNSYLVANIA.

NORTHAMPTON COUNTY.

MONARCH SLATE COMPANY.—This company has been incorporated at Bangor, with a capital of \$50,000.

STERLING SLATE COMPANY.—A charter has been issued to this company, of Walnutport, with a capital stock of \$75,000.

UTAH.

BEAVER COUNTY.

HORN-SILVER.—The company has been clearing its yards at the smelters south of Salt Lake of all the matte. About 800 tons of matte was sold to the Germania Company, and it is worked through the furnaces with raw ores.

BEAVER AND MILLARD COUNTIES.

DICKERT & MYERS SULPHUR COMPANY.—Twelve cars of sulphur from this company's property have been shipped to Kansas City, and eleven to Denver for distribution through the Southern country.

SUMMIT COUNTY.

BALTIMORE.—At the company's property at the head of the left-hand fork of Thayne's Cañon, which has been idle for some time on account of the bad air encountered in the tunnel, which is in about 600 feet, operations will be resumed as soon as the new blower that has been just received can be put in place.

CRESCENT.—The usual force of men is employed, and ore is accumulating at a rapid rate, and when the tramway and roads are again open, the concentrator will resume operations.

DALY.—Between fifty and sixty tons of ore a day are shipped to the Marsac mill, besides what is shipped to the sampler.

SAMPSON.—The drift which was started in the drain tunnel about 1000 feet from its mouth to cut

the ledge at depth, it is expected will be done about the latter part of March. Then a drift will be driven on the ledge to the neighborhood of the shaft for drainage, and the ground will then be in a condition for stoping to a depth of over 500 feet.

WISCONSIN.

EXCELSIOR.—This company has been incorporated at Wausau, with a capital stock of \$500,000, for the purpose of doing a general mining business.

WYOMING.

CARISA.—The company is pushing work on this mine. The second shaft is down 120 feet. Three hundred feet is the contemplated depth. This is eighty feet lower than the bottom of the old shaft. Stock in this mine has been largely sold in the East this winter. The company owns a number of other mines, all of which are under survey for patents.

BULLION PRODUCTION FOR 1886—SPECIAL OFFICIAL REPORTS.

MINES.	States.	Month	Year from
		of	Jan. 1st,
		January.	1886.
		\$	\$
Boston & Montana, G.	Mont...	81,583	.....
Caedonia, G.	Dak....	25,464	.....
Christy, S.	Utah...	23,555	.....
Colorado Central, S.	Colo...	24,844	.....
Derbec Blue Grav., G. S.	Cal....	15,759	.....
Elkhorn, G. S.	Mont...	23,456	.....
Eureka, S. L.	Nev....	15,905	.....
Father de Smet, G.	Dak....	17,452	.....
Freeland, G. S. C.	Colo...	19,187	.....
Granite Mountain, S.	Mont...	113,600	.....
Hope, S.	Mont...	6,200	.....
Iron Hill, S.	Dak....	8,152	.....
Lexington, G. S.	Mont...	62,850	.....
Montana Limited, G. S.	Mont...	100,831	.....
Moulton, G. S.	Mont...	62,050	.....
New Pittsburg, S.	Colo...	2,060	.....
Plymouth Consolidated, G.	Cal....	55,683	.....
Plutus, G. L. C.	Colo...	24,627	.....
Ropes, G. S.	Mich...	3,151	.....
Standard Consolidated, G.	Cal....	19,309	.....
Total			

G., gold; S., silver; L., lead; C., copper; M., mics. Silver valued by the different companies from \$1 to \$1.29 per ounce; gold, \$20.67. *Not including value of lead and copper. †Royalty. ‡Net. — No shipments during month mentioned. ** Not official.

MARKETS.

Silver.

NEW YORK, Friday Evening, March 5.

DATE.	LONDON.		DATE.	N. Y.	
	Pence.	Cents.		Pence.	Cents.
Feb. 27	46 3/4	102 1/2	Mch. 3	46 13 16	102 1/2
Mch. 1	46 13 16	102 3/4	4	46 3/4	102 1/2
2	46 13 16	102 3/4	5	46 3/4	102 1/2

There is nothing of any importance to note of the silver market abroad or here.

Foreign Bank Statements.—The governors of the Bank of England, at their regular weekly meeting, made no change in the bank's minimum rate of discount, and it remains at 2 per cent. During the week, the bank lost £332,988 bullion; and the proportion of its reserve to its liabilities was reduced from 49 1/4 to 46 1/16, against 46 1/16 per cent at this date last year. The bank lost £46,000 bullion on balance. The weekly statement of the Bank of France shows gains of 20,135,000 francs gold, and 1,728,000 francs silver.

United States Mints.—The statement of the United States mints for February shows the coinage to have been as follows: 479,510 pieces of gold valued at \$2,949,637.50; 2,600,000 pieces of silver valued at \$2,600,000.00; total coinage 3,079,150 pieces, value \$5,549,637.50.

Copper.—This market is very firm, with an advancing tendency, which has assumed the practical shape of higher prices actually received in some cases. We quote Lake 11 1/2 c. and Orford and Baltimore 10 1/2 @ 10 3/4 c., according to quality, the latter figure being obtained for grades equal to Arizona.

We hear of foreign orders offering for Lake 11 c. for export, but we do not learn of any having been obtained at that figure. On the contrary, there is a very decided feeling that copper will be higher in the near future, an impression confirmed by the enormous consumption of copper going on in this country. In our report of production, published in the ENGINEERING AND MINING JOURNAL, January 30th, we estimated the consumption in 1885 as 94 1/2 million pounds. The fuller returns we have since received show the production of some of the Mon-

tana mines to have exceeded the first estimate. The Clark's Colusa, for example, produced about 10,000,000 pounds instead of 6,000,000, and the Anacosta also exceeded our estimate, so that the consumption of copper in this country must have amounted to fully 100,000,000 pounds in 1885, or an increase of about 23 1/2 per cent over the consumption of 1884; and apparently the increase in consumption continues, for we hear of manufacturers calling for their supplies in advance of their contracts, and we hear also of 140 tons American matte returning from England to be refined and consumed here.

The English market has gone up somewhat during the last few days, and is very strong. Cables to the Metal Exchange quote Chili Bars at £41 7s. 6d. Best Selected, £45.

Manufactured copper we quote here 16 @ 16 1/2 c. Sheets; 16c. for Braziers'; 16 @ 16 1/2 c. for Bolts; and 14 3/4 @ 15c. for Rods.

Tin.—This market has been steady, with slightly higher figures, though without any material change. We quote here: 20 70 @ 20 85c. for spot and March. Cable advices quote: Spot, £93, and three months, £93 7s. 6d.

Lead.—This market has been quiet during the week, and some Foreign has been sold at 4 90c. for Common to 4 95c. for Refined. Our Western markets are selling at figures equal to 5c. in New York.

Sales during the week amounted to only a few hundred tons. We quote 4 90 @ 4 95c. for Foreign and 5c. for Domestic.

On another page will be found Mr. Kirchhoff's statistics of production of lead in 1885. The amount is given at 130,667 tons, or about 9000 tons less than in 1884. As the stock was greatly reduced in 1885, these figures fully confirm the reports in these columns during the year, and they also indicate the probability of foreign lead coming in for some time to come to supply our home demand. It must, however, be remembered that the higher price recently attained will have a tendency to check consumption, as well as increase production, so that the amount of lead required from abroad may very easily be over-estimated. Cable advices to-day quote soft Spanish lead in London, £13 7s. 6d., and English lead £14, which shows an advance of 5s. in Spanish, and 10s. in English during the week. Some foreign lead sold during the week as low as 4 85c.

Messrs. John Wahl & Co., of St. Louis, telegraph us as follows to-day:

Market very firm. Both Common and Refined worth 4 75c., with sales at this figure in a retail way. Offerings very light.

Messrs. Everett & Post, of Chicago, telegraph to us as follows to-day:

Since our last report, sales of both Soft and Hard lead have been more free, and several hundred tons have been purchased at 4 75c. Buyers, expecting a decline, are holding off, and buy only for immediate wants, and now holders, anticipating better prices, have withdrawn from the market at present, and refuse to make sales for future delivery at present prices, or at less than 4 80c. The statistical position remains unchanged. We see no reason for a decline in prices at present. Spot lead is scarce.

Spelter.—There is nothing new in this metal beyond a slight advance. Very little is now done in this market in this metal. We quote 4 50 @ 4 75c., according to quality, for Domestic, and 5 @ 5 10c. for Foreign.

The London market has declined somewhat, and is now quoted £14 15s. for Silesian at shipping ports.

Antimony.—This market remains quiet and steady at 8 1/2 @ 8 3/4 c. for Hallett's, and 9 @ 9 1/4 c. for Cookson's. London cables quote Hallett's £34 10s., which is a decline from a week ago.

IRON MARKET REVIEW.

NEW YORK, Friday Evening, March 5.

American Pig.—This market is very quiet, and business only moderate. Prices remain unchanged at \$18 @ \$18.50 for No. 1 X; \$17 @ \$17.50 for No. 2 X; and \$16 @ \$17 for Forge, standard Lehigh brands, tide-water delivery. Forge appears to be in best demand. Special irons, such as Glendon, Chickies, and a few other brands, ask as much or even more at the furnace than the other companies do at tide-water.

Scotch Pig.—This market is very dull, and may be quoted as follows: Colkness, \$20.50 @ \$21; Sumnerlee, \$20; Dalmellington, \$19; Eglinton, \$19;

Cables to the Metal Exchange to-day quote Coltness 47s.; Summerlee, 47s.; Langloan, 44s. 6d.; Gartsherrie, 43s.; Glengarnock, 45s.; Dalmellington, 41s. 6d.; Eglinton, 40s.; which is a general advance of about 3d. per ton during the week. Freights are still high, about 7s. d. 6

Bessemer Pig.—But little business is being done in this article. Importers overestimated the amount the market would require, and prices are flat. We quote \$19 for Foreign.

Spiegeleisen.—The market is somewhat lower and dull. We quote English 20 per cent nominally at \$27; German, \$26.

Steel Rails.—We hear of sales of some few thousands of tons, but the market is dull and somewhat unsettled, owing to the uncertainties of the tariff legislation, though there are few makers who believe any change will be made.

Quotations at Eastern mills are still \$34@34.50 or \$35 for prompt small orders. We hear of English rails having been offered at £4 8s. 6d., equal to \$21.36 f. o. b. ship for export to San Francisco. The freight is 16s., or \$3.88, and duty \$17, making a delivered price to San Francisco \$42.24, at which we understand they have been offered. This price would be reduced \$2 per ton for Galveston or New Orleans. Counting freight from here to San Francisco at \$7, and the price at the mill \$35, the price of American rails there would be \$42. If the duty were as proposed by the Morrison bill, 50 per cent *ad valorem*, rails would have to sell here at about \$28 a ton to compete with English rails at £4 8s. 6d. With the recent advance in wages and material, this price would be unprofitable to most of our mills.

A committee of prominent steel manufacturers has gone from Pittsburg to lay before the Tariff Committee the needs of the steel-makers, and we have no doubt they will be able to show the necessity for leaving the duties on steel and iron as they are.

There are large orders in the market, and every thing promises to give our mills full work throughout the year, should the present duty on rails remain unchanged.

Structural Iron and Steel.—The demand for bridge iron and steel continues active, and promises to assume a high aggregate during the year. The same is true of many other classes of structural iron and steel, but prices remain unchanged. We quote Angles, 1'95@2'10c. delivered; Tees, 2'35c.; Iron Beams and Channels, 3c. for American from dock; and Belgian, 2'60@2'75c.

Plate Iron.—Common Tank, 1'95@2c.; Refined, 2'¼c.; Flange iron, 3'4@3'5c.; Extra Flange, 4@4'25c.

Bar Iron.—Refined we quote at 1'85@1'95c.; Common, 1'60@1'70c. Store prices are 10@20c. higher.

Steel Plates.—We quote 2'¼c. for Tank; 3@3'¼c. for Boiler and Ship Plates; 3'¾@4c. for Flanges; 4'¼@5'¼c. for Extra Flange and Fire-Box Plate.

Merchant Steel.—Our quotations remain, American Tool Steel, 8@10c.; special qualities, 12@18c.; Crucible Machinery, 4'½@5'½c.; Bessemer and Open-Hearth Machinery, 2'½@2'¾c.

Old Rails.—Weaker under free offerings. Market quiet. We quote \$20.50@21 for Tees and \$21.50 for Double-Heads.

A good many Southern rails are now offering; and as spring opens, the repairs of Northern roads will recommence, when large amounts of old rails will come on the market. The uses for old rails are constantly increasing, and the stock will apparently all be consumed. There is little room for fresh importations at present.

Old Steel Rails are quoted at \$19.

Scrap-Iron.—\$20.50@21.50 for Selected Scrap from yard. A sale of Foreign Scrap was made at \$20 ex ship.

Philadelphia. March 4.

[From our Special Correspondent.]

The demand for pig-iron has rather suddenly fallen off, in spite of the fact that consumption is increasing and that supplies are dangerously scarce. This anomalous condition is scarcely explainable. Certain brands of Gray Forge are not to be had. Even ordinary and inferior irons are not offered so liberally as they were a month ago, and better prices are asked, ranging from 25 to 75 cents a ton, which probably accounts for the decline in demand. The advance in crude material without a corresponding advance in refined can not go any great lengths.

Crude has about done its best, and must stay where it is, unless manufacturers can get more for their product. The best prices are \$20 for No. 1 Foundry; \$18 for No. 2; and \$17.50 for Forge. There is a good deal of iron to be had at \$17.50@18 for No. 1; \$16@16.50 for No. 2; and Gray Forge down as low as \$15.50. The buyers who have been around the market this week have been small foundry and mill men who are in the habit of buying from week to week. Several of them have but very little iron in their yards; but having a few orders on hand and not feeling sure of getting more very soon, they are not in an anxious frame of mind for stocks.

Foreign Iron.—Bessemer iron is quiet, and quoted at \$19@20. Spiegeleisen is dull at \$27.50@28. There were rumors to-day of transactions of both Bessemer and spiegeleisen that might be closed this week, but inquiry develops the fact that no new offers of orders have been placed on the market. There are some unfilled orders that will be taken care of as soon as the market is in a proper condition.

Muck-Bars.—A sale of Muck-Bars was made to-day at \$29.50.

Blooms.—The bloomary interests are looking up business, and are taking some few orders at very small margins.

Merchant Iron.—The manufacturers account for the receipt of but few orders during the past week on the ground of bad weather, and predict that, with the change now at hand, a great deal of business will be presented. Most of the mills are in need of it. Very few are sufficiently sold up to be fully satisfied. The past few days have developed a better demand for car iron than any other kind. Refined iron is selling slowly at \$1.80@1.90, and medium at \$1.70. There have been some inquiries for large lots, but no sales. A great deal of work is to be given out within the next two weeks that will make business active at the bar mills. There are good reports from the ship-yards, car-works, locomotive-works, and some other establishments, all of which point to a sharp improvement in business.

Nails.—Nails are \$2.40@2.50, with nothing to report.

Plate Iron.—Fifty-ton orders for plate iron have been taken and considerable business done, though not one half of the business in sight has reached the order-books at the mills. Plate iron is 1'90@2c.; Skelp, 1'80@1'85c.; Tank, 2c. The manufacturers are not as a rule shading prices. They think the legitimate demand will keep their capacity running full, and feel they should have better rather than poorer prices.

Wrought-Iron.—Nothing new has taken place in wrought pipe, and the discounts are firm.

Sheet-Iron.—The sheet mills have increased their orders, and are doing better than other mills for galvanized iron. There is an active inquiry for building purposes, and the demand generally will be heavy. Card rates are not liable to change.

Structural Iron.—Angles are quoted all the way from 1'80@2c.; Beams, 3c.; Tees, 2'30c. for the orders coming in, though the business is rather small. For some reason, a great deal of business that was looked for early in the month is held in abeyance, but all the manufacturers say the year's business will not be disappointing.

Steel Rails.—Steel rails are firm in price. No very large orders have been placed. The aggregate of small orders is up to the average. There are inquiries for large supplies. A few manufacturers have gone to Washington this week to look into tariff interests in connection with the delegates from the Western end of the State.

Pittsburg. March 4.

Note that in these reports the cash value of iron, steel, and other articles is given. The difference in this market between cash and 4 months is 50 cents a ton, which the reader can take account of.

Pig-Iron.—We may report a steady, firm market, with an increase in values of 25 cents a ton, with a fair supply on hand. Holders of favorite brands are in no hurry to sell; while they are willing to supply regular customers with limited amounts, they have no desire to sell for future delivery. The current rates are as follows:

Coke or Bituminous:	Lake Ore.	Native Ore.
Foundry No. 1	\$17.50@18.00	\$17.50@18.00
Foundry No. 2	16.75@17.25	16.50@17.00
Gray Forge No. 3	16.00@16.25	15.50@16.00
Gray Forge No. 4	15.25@15.50	
White	14.50@14.75	13.75@14.00
Mottled	14.25@15.00	14.00@14.50
Bessemer		20.00

Charcoal:	
Foundry No. 1	\$21.50@23.00
Foundry No. 2	21.00
Cold blast	25.00@28.00
Warm blast	18.00@24.00

Muck-Bars.—Firm, with a slight advance. We hear of sales made by a Pittsburg firm east of the mountains of several hundred tons at \$29.50@29.75. Sales 500 tons in our market to-day, \$28 cash.

Spiegel.—Steady, \$28.50@29.

Steel Blooms.—\$31@36.

Steel Slabs.—\$29@33.

Steel Rails.—Crop Ends, \$24. Steel Bloom Ends, \$23.

Old Iron Rails.—Declined; sales, 1000 tons, \$23.50@24.

Old Steel Rails.—\$22@22.50.

Wrought Scrap.—Easier; sales No. 1, 50 to 100-ton lots, \$19@19.50; No. 2, \$16.50@17.

Steel Rails.—Steady, \$35@35.50; Light Sections, \$35@42.

Bar-Iron.—Demand moderate, 1'70@1'75c.

Iron Nails.—Car lots, 60 days, \$2.25@2.30. Secretary George Wise, of the Western Association, furnishes the following: 948 machines running; week's increase, 46 machines. There are 1640 machines running in the West, as follows: 948 at manufacturers' scale, 17c.; 390 old, 21c.; 302 at 19c. Manufacturers are firm, and show no signs of giving in.

The outlook in our iron mills is as promising as could be desired. Many of the works are on double-turn. Out of 102 furnaces, 41 are single and 61 are on double-turn.

In steel mills, Hussey, Howe & Co.'s mill is on single-turn; Black Diamond Steel Mill, double; Singer, Nimmick & Co. have eight furnaces idle. The Edgar Thomson steel mill at Braddock is running to its full capacity, turning out 600 tons steel rails every twenty-four hours.

	Native ore.	Lake ore.
Foundry No. 1, cash	\$17.50@18.00	\$17.50@18.00
" " 4 mos	18.00@18.50	18.00@18.50
Foundry No. 2, cash	16.50@17.00	16.75@17.25
" " 4 mos	17.00@17.50	17.25@17.75
Gray Forge No. 3, cash	15.50@16.00	16.00@16.25
" " 4 mos	16.00@16.50	16.50@16.75
" " No. 4, cash		15.25@15.50
" " 4 mos		15.75@16.00
White, cash	13.75@14.00	14.50@14.75
" " 4 mos	14.25@14.50	15.00@15.25
Mottled, cash	14.00@14.50	14.25@15.00
" " 4 mos	14.50@15.00	14.75@15.50
Silvery, cash	15.50@15.75	15.50@17.50
" " 4 mos	16.00@16.00	16.00@19.00
Bessemer, cash		20.00@
" " 4 mos		20.50@

Charcoal:	
Foundry No. 1, cash	21.50@23.00
Foundry No. 2, cash	21.00@
Cold-Blast Car Wheel	25.00@28.00
Warm-Blast	18.00@24.00

Anthracite:	
Foundry No. 1, cash	17.00@
" " 4 mos	17.50@
" " No. 2, cash	16.50@
" " 4 mos	17.00@
Gray Forge, cash	16.50@
" " 4 mos	17.00@
20 per cent Spiegel	28.50@29.00
Muck-Bar	28.00@28.50
Steel Blooms	31.00@36.00
Steel Slabs	29.00@33.00
Steel Rail Crop Ends	23.00@
Steel Bloom Ends	23.00@24.00
Old Steel Rails	22.00@22.50
No. 1 Wrought Scrap	19.00@19.50
No. 2 Wrought Scrap	17.00@17.50
Steel Rails	35.00@35.50
" " light sections	35.00@42.00
Bar Iron	1.70@1.75
Iron Nails, 60 days, car lots	2.25@2.30
Steel Nails	nothing doing.

COAL TRADE REVIEW.

NEW YORK, Friday Evening, March 5.

Statistics.

Production of Coke on line of Pennsylvania RR. for week ended February 27th, and year from January 1st:

Tons of 2000 pounds.	—1886.		—1885.	
	Week.	Year.	Week.	Year.
Allegheny Region	3,431	29,498	3,644	30,728
West Penn. RR.	2,107	15,917	635	1,241
Southwest Penn. RR.	20,830	191,512	35,498	288,246
Penn. & W. Region	8,295	52,626	6,133	44,589
Monongahela	109	7,266	1,100	10,623
Pittsburg Region				
Snow Shoe	875	6,425	240	3,137
Total	35,647	303,214	47,250	378,584

The Norfolk & Western Railroad Company reports the shipments of Pocahontas Flat-Top coal for the week ended February 27th, 1886, and year from January 1st as follows, tons of 2000 pounds: 1886—Week, 10,287; year, 113,894. 1885—Week, 10,219; year, 77,210. Increase, 1886—Week, .08; increase, year, 36.684.

Production Anthracite Coal for week ended February 27th, and year from January 1st:

Tons of 2240 lbs.	1886.		1885.	
	Week.	Year.	Week.	Year.
P. & Read. RR. Co.	185,722	1,454,999	134,942	1,184,428
L. V. RR. Co.	122,675	944,963	32,742	622,842
D. L. & W. RR. Co.	111,248	893,170	99,730	537,498
D. & H. Canal Co.	109,381	719,123	51,108	405,922
Penna. RR.:				
N. & West Br. RR.	27,061	219,868	16,903	172,167
S. H. & W. B. RR.	2,840	25,020	2,851	18,754
P. & N. Y. RR.	9,253	202,060	3,148	50,682
Penna. Coal Co.	25,826	163,053		78,083
Shamokin Div., N. C. RR.	24,441	145,601	23,666	130,413
Lykens Valley.....	9,000	72,081	9,362	71,958
Total.....	627,447	4,840,538	374,452	3,272,747
Increase.....		1,567,791		
Decrease.....	252,995			

* Estimated.
The above table does not include the amount of coal consumed and sold at the mines, which is about six per cent of the whole production.
Production for corresponding period:
1881..... 4,040,900 | 1883..... 4,054,563
1882..... 3,739,839 | 1884..... 3,670,114

Production Bituminous Coal for week ended February 27th, and year from January 1st:
Tons of 2000 pounds, unless otherwise designated.

	1886.		1885.	
	Week.	Year.	Week.	Year.
Philo. & Erie RR.	272			
*Cumberland, Md.	44,257	303,619	21,827	268,233
*Barclay, Pa.	3,669	34,362	7,611	44,754
*Broad Top, Pa.				
H. & Broad Top RR.	7,669	47,183	2,809	24,085
East Broad Top.....				
Clearfield Region, Pa.				
Snow Shoe.....	3,202	23,841	4,586	34,400
Karthaus (Keating)	2,298	16,542	2,623	31,165
Tyrone & Clearfield	55,381	434,232	64,275	491,501
Allegheny Region, Pa.				
Galitzin & Moun- tain.....	14,973	106,186	10,601	80,877
Total.....	131,449	966,237	114,332	975,015

* Tons of 2240 lbs.

WESTERN SHIPMENTS.				
	1886.	1885.		
Pittsburg Region, Pa.				
West Penn RR.	5,000	37,308	4,545	41,546
Southwest Penn. RR.	2,485	17,860	2,058	17,412
Pennsylvania RR.	4,134	36,476	6,944	36,228
Westmoreland Region, Pa.				
Pennsylvania RR.	40,067	232,594	21,653	182,917
Monongahela Region, Pa.				
Pennsylvania RR.	2,306	25,989	6,934	35,433
Total.....	54,001	350,227	42,134	313,536

Grand total..... 185,450 | 1,316,464 | 156,466 | 1,288,551
‡ Considerable gas-coal shipped East, of which no division is made in report.

Anthracite.

The cold weather of the week under review has undoubtedly caused an increase in the consumption of anthracite coal; but the very large production has not only met this, but has blocked every thing at tide-water. Prices have fallen off, and still show a strong downward tendency. Late Saturday, or early on Monday, the Pennsylvania Coal Company announced an open reduction of 10 cents a ton on stove, egg, and broken sizes, and 5 cents on chestnut. This was promptly met by the other companies.

Upon the surface, nothing has been accomplished toward forming a coal combination. There is a feeling, however, that this, like the reorganization of Reading, will largely fall upon a syndicate. What syndicate, it is hard to say. Things are so much mixed that it is difficult, if not impossible, to determine what is what or which which. A Morgan-Welsh syndicate started out a month ago to reorganize Reading, advance the price of coal \$1 a ton, establish harmony among the trunk lines, and generally build up confidence and start the country upon the road to prosperity.

We do not propose to trace back to the cause from the effect, but it is certain that since this "grand plan" was inaugurated, the trunk lines have established a war of rates, coal has steadily declined in price, and the present appearances are, that this great syndicate has had to abandon the vital element of its plan, and has had to go to Mr. Gowen; and the reorganization of the Reading on an independent basis, free from the dangerous control of the Pennsylvania Railroad, will now, it is to be hoped, be promptly effected.

Only a very few persons appear to have any knowledge of the full plans of the syndicate or of Mr. Gowen, or who or what powers control its operations. Most of the reports announce that the Pennsylvania Railroad is completely left. This may be so, but we hardly believe it. We think at least a bone will be thrown to that company. If this be not the case, we fear they will be disappointed in the expectation of early prosperity in the coal trade.

The syndicate is said to control Delaware, Lackawanna & Western; prominent gentleman in that company are said to have put \$1,000,000 into the syndi-

cate. Mr. Astor, who is the controlling influence in Delaware & Hudson, is said to have put in \$1,000,000. As the Lehigh Valley Railroad and the Pennsylvania Coal Company have always been reasonably inclined, we think that, when the powers have sufficiently advanced their plans in other directions, it will take but a short time to form a coal combination.

The companies claim to be asking net f. o. b. as follows: Stove coal, \$3.10; Chestnut, \$2.90; and Broken and Egg, \$2.70. We hear of Egg coal sold at \$2.50 by a large and strong company. In fact, buyers for round lots, for prompt delivery, can almost name their own terms.

We quote for ordinary free-burning coals f. o. b. as follows:

	Week ended—	
	March 5th.	February 26th.
Lump.....	\$2.80@3.00	\$2.80@3.00
Steamboat.....	2.80@ 3.00	2.80@ 3.00
Broken.....	2.60@ 2.80	2.65@ 2.80
Egg.....	2.60@ 2.80	2.65@ 2.80
Stove.....	3.00@ 3.15	3.00@ 3.25
Chestnut.....	2.75@ 3.10	2.85@ 3.00
Pea.....	1.40@ 1.75	1.50@ 1.75
Buckwheat.....	1.25@ 1.50	1.25@ 1.50
Dust.....	1.00@ 1.10	1.00@ 1.15

We hear of pea coal offered f. o. b. here for delivery during the entire year at \$1.50 a ton, and buckwheat at \$1.20 a ton.

Bituminous.

Our Boston letter gives a list of very important contracts that have recently been made for bituminous coal, at prices far below those of last year.

The heads of the Knights of Labor have ordered a general strike in the bituminous districts to take place next Monday, unless their demands for an advance in wages, previously noticed by us, are made.

At a meeting of the Bituminous Coal Exchange, held in Philadelphia, February 26th, to consider the question of an advance of wages in the Clearfield and Mountain regions, it was resolved positively to decline to make any advance in wages at this time. "The extremely low prices that we are compelled to sell coal for, in order to meet existing competition, will not allow us to give an advance, it being difficult to get actual cost, let alone any profit."

The Cumberland companies have taken somewhat similar action.

A year ago, anthracite, broken, and egg coal was selling at about \$3.45 alongside in this city, while no attempt was made to secure more than \$3.25 a ton for bituminous coal. At present, broken and egg can be purchased in quantity at \$2.80 or even less, showing a decline of quite 65 cents a ton. Last year, there was but little if any profit to the bituminous operators. If they are to continue to meet the competition of low anthracite and at the same time pay higher wages, they may as well close their mines at once. The large Eastern contracts made show how utterly impossible it will be for the companies to increase their cost of production this year.

Proposals will be received at the Grand Trunk Railroad general offices at Montreal, Canada, up to March 18th for steam coal required during the present year, as follows: At Portland (by water), 25,000 tons gross; Chaudière Junction (by rail), 25,000 tons gross; Montreal (by water or by rail, via Chaudière), 68,000 tons gross; Brockville (by water), 25,000 tons net. Coal brought to Montreal and Brockville by water to include carriage to and piling in company's yard. Company's weights to be accepted in all cases.

Buffalo.

March 4.

[From our Special Correspondent.]

The anthracite coal trade is active for home consumption and near-by points in consequence of severe weather. No variation is made in the quotations for local use as regulated by the Exchange. With regard to the future, "All quiet!" is the answer to queries, and no foreshadowings of the policy to be pursued relative to prices, etc., are observable on the surface, or can be drawn from the dealers by hook or by crook. It is understood, however, that stocks are accumulating at many points in consequence of the disinclination of jobbers to purchase while uncertainty prevails as to the settlement of the pooling question, and further, that cutting at Eastern points still prevails to a considerable extent.

The item taken from a local journal relative to the Grand Trunk soft coal contract, which appeared in last week's letter, was incorrect; the writer was not quite posted. It is understood that 280,000 tons were contracted for, really to the same parties as obtained it last year—namely, 125,000 tons to Messrs. Bell, Lewis & Yates, 130,000 tons to Mr. Galusha A. Grow,

and 25,000 tons to the Erie and Rochester & Pittsburg people. Mr. Grow represents the Brady's Bend Mining Company, whose mines are tributary to the Buffalo, New York & Philadelphia Railroad. The Erie gets the hauling of the Dugas mines, which are handled by Messrs. Bell, Lewis & Yates. The price to be paid for the coal is said to be about last year's figures, which were reported to be \$2.40 a ton at Suspension Bridge and \$2.25 a ton at International Bridge.

Coke is arriving again from the Connellsville region. Prices have advanced 15c. a ton. The late strike was a pretty expensive one to all concerned, and has taught a lesson that the laborer and the syndicate will do well to reflect upon.

News is light this week. The following are the only jottings that are worth sending forward.

There is nothing new relative to the introduction of natural gas, the Common Council awaiting the special committee's report of the result of the investigations alluded to in my last letter.

Opposition to this State asking for Federal aid to enlarge and improve the Erie and Oswego canals, coming from many influential newspapers, has thrown a damper on the advocates of the plan. Strong efforts are to be made to enlighten the people upon the subject from the said advocates' stand-point, and a special committee of the Merchants' Exchange has taken the initiatory steps.

A dispatch from Philadelphia says that the Pennsylvania, Baltimore & Ohio, and the Beech Creek railroad companies, acting for the shippers of soft coal over their lines, have informed these shippers that the pool formed by them beginning operations March 1st has agreed to advance prices 30 cents a ton. An increase in the wages paid to miners accounts for a portion of the rise.

Boston.

March 3.

[From our Special Correspondent.]

Trade continues in an unsettled state, so far as anthracite coal is concerned. Affairs have been running along this way for four or five weeks now. The prevailing opinion is, that a combination is coming; but it does not yet appear, and it is not at all improbable that it will be made to do further service in aid of stock speculation if it does come. While the combination is withheld, prices rule as low as at any time since the talk of a combination was begun. There is more demand for coal, although dealers are buying in a rather small way. Retailers have reduced their prices this week, which is a good indication that they are beginning to take on coal bought at lower prices. F. o. b. prices at New York are fully reported in the New York report. It is reported that brokers of the Philadelphia & Reading Railroad are pushing more actively for orders than heretofore.

There is an active movement in bituminous coal. An exceptionally large amount of coal has been sold in the few weeks past, and that without any stir. The endeavor to sell more coal f. o. b. than heretofore is not meeting with much success. Manufacturers and railroad men have seen the advantage of delivered prices too often to take the risk of f. o. b. prices themselves. All signs point to a heavier soft coal tonnage to New England ports this year than ever before; but the extreme low prices at which orders are taken will prevent shippers from making the handsome thing out of this movement that they could otherwise do. Now and then, another concern takes bituminous in place of anthracite coal, but nearly every manufacturer is using soft coal already where he can do so. As for prices, there is no standard. Opening nominally at the basis of \$2.25 at Baltimore and \$2.35 at Philadelphia, Newport News, and Norfolk, they have declined to \$2.15 at Baltimore and \$2.25 at other ports. Offers to sell at \$2.10 at Baltimore are made this week, and one firm is reported selling its coal at \$2, but whether true or not we can not say. The delivered prices continue to range about \$3.35, and there seems to be no alternative but that lower figures were made only after some private understanding with the railroads.

Recent large contracts that have come to the surface include the Boston & Maine Railroad for 100,000 tons (given to two or three shippers). The annual consumption of this road on all of its divisions is 150,000 tons; but it is said to have considerable coal left over from last season's contracts, and may buy 25,000 tons later. The New York & New Haven people have bought 100,000 tons; Merrimack Mills, 25,000 tons; Concord Railroad, 20,000 tons; Amoskeag Mills, 15,000 tons. Only a few contracts can be traced, but it is evident that large buyers consider it a good time

DIVIDEND-PAYING MINES.

NON-DIVIDEND-PAYING MINES.

Main table with columns for Name and Location of Company, Capital Stock, Shares, Assessments, Dividends, and Date and amount per share of last. It lists 134 mines and their financial details.

G. Gold, S. Silver, L. Lead, C. Copper. * Non-assessable. + This company, as the Western, up to December 10th, 1881, paid \$1,400,000. † Non-assessable for three years. ‡ The Deadwood was previously paid \$275,000 in eleven dividends, and the Terra \$75,000. § Previous to the consolidation of the California and Consolidated Virginia in August, 1881, the California had paid \$31,321,000 in dividends, and the Consolidated Virginia \$42,931,000. ** Previous to the consolidation of the Copper Queen with the Adanta, August, 1885, the Copper Queen had paid \$1,350,000 in dividends.

NEW YORK MINING STOCKS.

DIVIDEND-PAYING MINES.

NON-DIVIDEND-PAYING MINES.

Table with columns for Name and Location of Company, Highest and Lowest Prices per Share at which Sales were Made (Feb. 27, March 1, 2, 3, 4, 5), and Sales. It is divided into Dividend-paying and Non-dividend-paying mines.

Dividend shares sold, 35,575. Non-dividend shares sold, 20,200.

to buy. It is estimated that from 50 to 60 per cent of the whole season's business has been contracted for, and no real attention has been paid to the "pool" in it all.

There is a little easier feeling in freights.

We quote, exclusive of discharging:

New York, \$1; Philadelphia, \$1.25; Baltimore, \$1.35; Newport News, \$1.15@1.20; Richmond, \$1.25; Cape Breton, \$1.60@1.75; Bay of Fundy, \$1.40@1.50.

Retail prices have been reduced 25 cents a ton on ordinary coal and 50 cents a ton on Franklin. We quote:

Franklin Egg and Stove, \$7.00; Lorberry, 6.50; Shamokin Egg, \$5.50@6.00; Stove, 5.75@6.00; Lehigh Furnace, Egg and Stove, 5.25@5.50; Nut, 5.50@5.75; White Ash Furnace and Egg, 4.75@5.00; Stove and Nut, 5.50@5.75; Cannel, American, 10.00@12.00; English, 14.00@15.00.

Wharf prices: Broken, \$4.25@4.50; Egg, \$4.25@4.50; Stove, \$5.

Pittsburg. March 4.

The February coal shipments from Pittsburg by the Ohio River were 11,042,000 bushels, destined principally for the Southern markets. The market is very dull here and at all the leading cities. Just think of buying the land, digging the coal, and transporting (towing) it 500 miles, and selling it afloat at 5@6 1/2 c. a bushel!

Prices in this market: River, wholesale, on board, 4@5c. a bushel. Railroad, 4 1/2@4 3/4 c. a bushel. Cincinnati: Wholesale, 5@6c. a bushel. Louisville: Wholesale, 5@6 1/2 c. a bushel.

The whole coke region remains in a very unsettled condition. Present asking rates f. o. b. cars at ovens: Blast-Furnace, \$1.35; Foundry, \$1.50 a ton; crushed coke, \$1.80@2 a ton.

The mines along the Monongahela are in full operation, with a large amount of coal ready for shipment. There was a good stage of water the first of the week, but only one steamer with a tow ventured out - the ice was entirely too formidable, destroying the wheels of steamers and endangering the safety of boats and their cargoes.

New Orleans. March 2.

[From C. A. MILTENBERGER & Co.]

We begin the spring season with a very small stock of Pittsburg coal on hand; barely three

weeks' supply being the total in market to-day. There is a good run on the way from the mines, which will swell the stock some during the current month, and now that the miners' troubles are over, and the ice does not interfere with the loading of coal, the output of the mines has increased to very large proportions. The operators will be kept busy, and will take advantage of every good stage of water: at Pittsburg to forward coal to the Southern markets. It will require fully three months of boating water to enable the operators to supply the wants of the sugar planters' trade, and to stock this market sufficiently for the summer and early fall demand. Whether the elements will favor the coal interests or not, we are not prepared to say. The demand for the past month slackened up considerably, and we do not look for any improvement during the current month, our cold weather being now over, and the steam trade becoming lighter as the season advances.

Wholesale prices are weaker, 28@30c. being now the market rate, while other quotations are unchanged.

FINANCIAL.

Mining Stocks.

New York, Friday Evening, March 5.

The mining market has presented no special features of interest; prices have been firm, and in a few instances have declined. The total transactions were 55,775 shares, showing a decrease of 2250 shares, as compared with the preceding week.

The Colorado stocks show but a small business. A few hundred shares of Iron Silver sold at from \$2.45@ \$2.50. At the annual meeting of this company, held this week, it was shown that the company was in a flourishing condition, and had a cash balance in the treasury, February 1st, of \$217,000. A dividend of \$100,000 was declared. The Supreme Court has reversed the decision in favor of this company on the working of a vein under the placer claim, and has sent the case back for a new trial. This probably has had a bearish effect upon the stock, which was expected to advance. Colorado Central sold at \$2.45. At the recent meeting, it was unanimously decided to diminish the capital stock from 300,000 to 275,000 shares, by canceling the 25,000 shares held as so-called treasury stock.

The dealings in the Comstock shares have been well

distributed throughout the list, but the business done in the different stocks has been small, and shows no great variation in prices. The largest business is recorded in Sutro Tunnel, at from 18@20c. Consolidated California & Virginia, at from \$2.40@2.50. Hale & Norcross is firm at from \$2.45@2.30. There were a few sales of Eureka at \$2. Navajo, at 35c. North Belle Isle, at 25c.

Bodie Consolidated has been active and firm at from \$1.60@1.50. Bulwer, at 62@63c. Standard, with a few sales at \$1.05. Mono has declared its first dividend, amounting to \$12,500; no sales have been made in the stock, which, during the last few months, has shown the greatest change in prices.

Horn-Silver showed a downward movement, going from \$3.55@3.20, closing at \$3.40; the sales amounted to 2825 shares. A sale of 20 shares of Ontario was made at \$29. Stormont ruled at 13c. and 14c.

Toward the close of the week, great activity was displayed in Father de Smet, with declining prices, going from \$2.15@1.45. The company has not paid any dividends so far this year, and the bullion production has also decreased, and to this the downward movement is probably due. Caledonia has been in sympathy with Father de Smet, and went from \$1.60@1.25; sales, 3620 shares. Homestake has ruled from \$18@13.50.

Another dividend of \$25,000 has been announced by the Silver King Mining Company, the stock of which sold at \$6.75 a share. Alice advanced from \$1.45 to \$1.60. Rappahannock, which shows the large business of 8300 shares, sold at from 11@13c.

The following securities were sold at auction in this city on the 3d inst.: \$10,000 New York, Lackawanna & Western Railroad, 1st mortgage 6 per cent bonds, due 1921, 130 3/4; 400 shares Delaware, Lackawanna & Western Railroad, 131 3/4; 50 shares Morris & Essex Railroad, 136 3/4; 24 shares Minnesota Mining Company, \$6 for lot; 103 shares Old Dominion Land Company, 28; \$300 Central Railroad of New Jersey, 7 per cent. adjustment bonds, 111; 178 shares the Hydro-Pneumatic Ore Mill Company, \$3 for lot; 200 shares Wyoming Valley Coal Company, 20.

Coal Stocks.

The week under review has had its surprises, and the public is still entirely at sea, and unwilling to take a hand in the market until it shows some well-defined

course. Traders are having things much their own way, and put the market up on bearish information, and put it down on good news.

The dealings in Delaware, Lackawanna & Western aggregate 711,237 shares, at \$125%@\$133%, closing at \$129%. Delaware & Hudson, with sales of 57,913 shares at \$101%@\$106%, closed at \$103%. Reading has been quite active, the transactions amounting to 486,650 shares, at \$24%@\$30, closing at \$28%. Jersey Central, with dealings of 142,649 shares, at \$53%@\$57%, closed at 54%.

The bituminous stocks show a little activity, but must necessarily be dull pending the results of the strike.

Meetings.

The annual and special meetings of the following companies will be held at the times mentioned:

Colorado Coal and Iron Company, company's office, Colorado Springs, Colo., April 5th, at twelve o'clock m.
Cordova Consolidated Mining Company, No. 61 Broadway, Room 43, New York City, April 14th, from twelve m. to two o'clock p. m.

Hydro Pneumatic Ore Mill Company, No. 7 Nassau street, Room 42, New York City, March 9th, a special meeting for consultation and action regarding its financial necessities.

Midland Mining Company, No. 234 South Fourth street, Philadelphia, Pa., March 16th, at twelve o'clock m.

Minnesota Mining Company, No. 35 Broadway, Room 40, New York City, at eleven o'clock a. m.

Rock Hill Iron and Coal Company, No. 320 Walnut street, Philadelphia, Pa., March 16th, at half-past eleven o'clock a. m.

Dividends.

Alice Gold and Silver Mining Company, of Montana, has declared a dividend of 6 1/4 cents a share, or \$25,000, payable March 10th, at the Farmers' Loan and Trust Company.

Granite Mountain Mining Company, of Montana, has declared a dividend (No. 16) of 20 cents a share, or \$80,000, payable March 3d.

Iron Silver Mining Company, of Colorado, has declared a dividend of \$100,000.

Mono Gold Mining Company, of California, has declared a dividend (No. 1) of 25 cents a share, or \$12,500, payable March 15th, at Messrs Laidlaw & Co.'s, No. 14 Wall street.

Philadelphia & Reading Railroad Company's receivers will purchase, March 8th, at the rate of five per cent, the interest and coupons of the Glentworth and Hartman & Myer Divisional Coal Land mortgage bonds of the Reading Coal and Iron Company, due March 1st.

Phoenix Iron Company gives notice that \$78,000 of its 7 per cent bonds have been drawn for the sinking fund and will be paid off at par on April 1st, when interest will cease.

Silver King Mining Company, of Arizona, has declared a dividend of 25 cents a share, or \$25,000, payable March 15th, at San Francisco.

ASSESSMENTS.

COMPANY.	No.	When levied.	Delinquent in office.	Day of sale.	Amount.
Alpha, Nev.		Mar. 3			.50
Alta, Nev.	33	Feb. 1	Mar. 5	Mar. 25	.25
Andes, Nev.	28	Feb. 16	Mar. 23	Apr. 12	.25
Baltimore, Utah.	1	Dec. 26	Feb. 1	Mar. 4	.01
Benton Con., Nev.	15	Feb. 4	Mar. 11	Mar. 30	.10
Best & Belcher, Nev.	33	Jan. 6	Feb. 10	Mar. 9	.50
Black Hills Oil, Dak.		Feb. —	Mar. 15	Apr. 10	.02
Bodie Tunnel, Cal.	12	Jan. 21	Feb. 27	Mar. 22	.15
Buchanan, Cal.	15	Feb. 9	Mar. 17	Apr. 5	.25
Con. Pac., Cal.	8	Feb. 18	Mar. 22	Apr. 15	.15
Courier, Utah.		Feb. 3	Mar. 11	Mar. 31	.03
Enterprise, Dak.		Feb. 6			.01
Far West, Dak.	7	Jan. 12	Feb. 16	Mar. 5	.02
Forty Nine, Cal.	1	Feb. 4	Mar. 15	Apr. 5	.10
Hale & Norcross, Nev.	89	Feb. 11	Mar. 18	Apr. 8	.50
Jupiter, Utah.		Jan. 4	Feb. 12	Mar. 11	.01
Johnson Gravel, Col.	3	Feb. 3	Mar. 8	Apr. 6	.02
Lady Wash., Nev.	5	Feb. 4	Mar. 9	Mar. 29	.05
Liberty, Dak.	1	Jan. 14	Feb. 15	Mar. 15	.01
Mexican, Nev.	31	Feb. 9	Mar. 15	Apr. 8	.25
Navajo, Nev.	14	Jan. 9	Feb. 15	Mar. 8	.30
Omilak, Alaska.	4	Feb. 20	Mar. 30	Apr. 17	.05
Ophir, Nev.	50	Feb. 4	Mar. 9	Mar. 29	.30
Peer, Ariz.	4	Jan. 17	Feb. 14	Mar. 5	.10
Peerless, Ariz.	7	Mar. 3			.23
Potosi, Nev.	22	Feb. 5	Mar. 9	Mar. 31	.30
Rainbow, Dak.	1	Feb. 2	Mar. 8	Mar. 27	1-10
Savage, Nev.	65	Jan. 4	Feb. 9	Mar. 7	.50
Seabur, Calkins, Dak.		Jan. 21	Mar. 1	Mar. 30	.02
Sierra Nevada, Nev.	84	Jan. 5	Feb. 9	Mar. 1	.25
Union Cons., Nev.	32	Jan. 11	Feb. 15	Mar. 8	.25

COAL STOCKS.

Quotations of New York stocks are based on the equivalent of \$100. Philadelphia prices are quoted so much per share.

NAME OF COMPANY.	Par value of shares.	Quotations of New York stocks are based on the equivalent of \$100. Philadelphia prices are quoted so much per share.										Sales from Feb. 27th to March 5th, inclusive.					
		Feb. 27.		March 1.		March 2.		March 3.		March 4.			March 5.				
		H.	L.	H.	L.	H.	L.	H.	L.	H.	L.		H.	L.			
Barclay Coal	100																
Cameron Coal	50	14%				14%	14	14%	14%	14%	14%	14%	14%	14%	14%	14%	8,000
Col. C. & I.	10	25		24%		25%	25	25%	25%	25%	25%	25%	25%	25%	25%	25%	5,557
Ches. & O. RR.	100							11%									40
Consol. Coal	100																
Cumb. C. & I.	100																
Del. & H. C.	100	103 1/4	102	102 1/4	101 1/4	105 1/4	101 3/4	106 1/4	104 3/4	105 1/4	103 1/4	104 3/4	103	103	103	57,913	
D., L. & W. RR.	50	128 3/4	126 3/4	126 3/4	125 3/4	131	125 3/4	133 1/4	131 1/4	131 1/4	129	130 3/4	128 3/4	128 3/4	128 3/4	711,237	
Elk Lick Coal Co.	100																
Lehigh C. & N.	50	50 1/2	50 3/4	51		51 1/2	51	52	51 3/4	51 1/2	51 1/2					5,350	
Lehigh Valley RR.	50	58 1/2		58 1/2		60	58 1/2	59 1/2	59	59 1/2						304	
L. & W. C. & I. Co.	100	12 1/2	12			12										300	
Maryland Coal	100																
Montauk Coal	100																
Morris & Essex	50					136 1/2				129 1/4		138 1/2				332	
New Central Coal	100					12		14	12 3/4	13						710	
N. J. C. RR.	100	54 1/2	53 1/2	54 1/2	53 1/2	56 1/2	54 1/2	57 1/2	56	56 1/2	54 1/2	55 1/2	54 1/2	54 1/2		142,649	
N. Y. & S. Coal	50																
Penn. Coal	50																
Penn. RR.	50	54 1/2	54 1/2	54 1/2	54	55 1/2	54 1/2	55 1/2	55	55 1/2	54 1/2					5,933	
Ph. & R. RR.	50	25 1/2	24 1/2	25 1/4	24 1/2	27 1/2	25	27 1/2	27 1/2	30	28 1/2	29 1/2	28 1/2			486,650	
Spring Mountain	50																
Westmoreland Coal	50																

* Of the sales of this stock, 93 330 were in Philadelphia, and 393 320 in New York.
† The quotations for these stocks are not percentage, but actual price. Total sales, 1,425,125.

DIVIDENDS PAID BY MINING COMPANIES DURING THE MONTH OF FEBRUARY AND FROM JANUARY 1ST, 1886.

NAME OF COMPANY.	Location of mines.	Paid during month of February.	Since January 1st, 1886.
Adams, S. L.	Colo.	\$15,000	30,000
Atlantic, C.	Mich.		40,000
Big Bend Hydraulic, C.	Dak.	6,000	6,000
Boston & Montana, C. S.	Mont.	30,000	60,000
Caledonia, C.	Dak.	10,000	20,000
Calumet & Hecla, C.	Mich.		500,000
Central, C.	Mich.	40,000	40,000
Colorado Central, S.	Col.	15,000	15,000
Cons. Cal. & Va., G. S.	Nev.	64,800	64,800
Derbec Blue Grav., G. S.	Cal.	10,000	10,000
Elkhorn, G. S.	Mont.	5,000	10,000
Freeland, G. S. C.	Colo.		20,000
Granite Mt., S.	Mont.	80,000	140,000
Hecla Con., G. S. L. C.	Col.	15,000	30,000
Helena Mg. & R., G. S. L. C.	Mont.	19,950	19,950
Holmes	Nev.	25,000	25,000
Homestake, G.	Dak.	50,000	100,000
Iron Hill	Dak.	12,500	12,500
Jackson, G. S.	Nev.		5,000
Manhattan, S.	Nev.	12,500	25,000
Ontario, S.	Utah	75,000	150,000
Paradise Valley, G. S.	Nev.	10,000	10,000
Plutus, G. S. C.	Colo.	20,000	20,000
Plymouth Con., G.	Cal.	25,000	50,000
Quicksilver Prf., Q.	Cal.	64,500	(4,000)
Quincy, C.	Mich.		160,000
Silver King, S.	Ariz.	25,000	50,000
Small Hopes Con., S. L.	Colo.	50,000	100,000
		\$620,300	\$1,777,750

G., Gold; S., Silver; L., Lead; C., Copper; Q., Quicksilver.

Pipe Line Certificates.

The following table gives the quotations and sales at the Consolidated Stock and Petroleum Exchange:

	Opening.	Highest.	Lowest.	Closing.	Sales.
Feb 27	79 1/2	80	79 1/2	79 1/2	2,736,000
March 1	79	79 1/2	78 1/2	78 1/2	7,753,000
2	78 1/2	79 1/2	78 1/2	79 1/2	2,485,000
3	79 1/2	80 1/2	78 1/2	79	4,445,000
4	79	79 1/2	78 1/2	79 1/2	3,372,000
5	79 1/2	80	79 1/2	79 1/2	3,206,000
Total sales					18,997,000

Boston Copper and Silver Stocks.

[From our Special Correspondent.]

BOSTON, March 4.

There was an active business in copper stocks in the early part of the week, and prices advanced quite rapidly under the large buying orders from the lake as well as at home. Under a desire to realize profits, however, the market began to droop, and for the past few days a quiet dullness has prevailed. The market has not declined materially, and is only taking a needed rest, and we look for a great deal more activity and higher prices in the near future. Calumet & Hecla advanced from \$225@\$230, with sales of 254 shares, and closed at the highest price. Tamarack sold at \$88—100 shares—which is the bidding price. Quincy was firm at \$49@\$50, and records sales of 234 shares. Franklin was in active demand, with sales of about 3550 shares at \$14@\$14 1/2. In the later dealings, it declined on small lots to \$13 1/2, but is wanted at that price. Osceola advanced from \$15 1/2@\$17, and held the advance, selling at the

San Francisco Mining Stock Quotations.

Daily Range of Prices for the Week.

NAME OF COMPANY.	CLOSING QUOTATIONS.					
	Feb. 26.	Feb. 27.	Mar. 1.	Mar. 2.	Mar. 3.	Mar. 4.
Albion						
Alpha						
Alta		.15	.10	.10	.10	.35
Argenta						
Bechtel						
Belcher	1.12 1/2				1.00	1.2 1/2
Belle Isle						
Best & Belcher	1.50	1.50	1.62 1/2	1.75	1.62 1/2	1.62 1/2
Bodie		1.62 1/2	1.62 1/2	1.62 1/2	1.62 1/2	1.50
Bullion						
Bulwer		.60	.60	.60	.60	
Chollar	.95	1.00	1.25	1.25	1.25	1.12 1/2
Con. Pacific		.25	.30	.30	.30	.25
Con. Cal. & Va.	2.25	2.25	2.37 1/2	2.37 1/2	2.50	2.37 1/2
Crown Point	1.12 1/2				1.12 1/2	1.12 1/2
Day						
Elko Cons						
Eureka Cons	2.00	2.00	2.12 1/2			
Exchequer						
Gould & Curry	1.00	1.00	1.12 1/2	1.12 1/2	1.12 1/2	1.12 1/2
Grand Prize						
Hale & Norcross	2.25	2.25	2.37 1/2	2.25	2.12 1/2	2.12 1/2
Independence						
Martin White						
Mexican	.40	.40	.40	.40	.40	.50
Mono	3.87 1/2	4.00	4.00	4.12 1/2	4.12 1/2	4.00
Mount Diablo			.40	.35	.35	.35
Navajo	.40		.40	.35	.35	.35
Northern Belle						
North Belle Isle						
Ophir	.55	.55	.60	.60	.60	.65
Overman						
Potosi	.35	.40	.50	.45	.55	.50
Savage	1.25	1.37 1/2	1.37 1/2	1.37 1/2	1.37 1/2	1.25
Scorpion						
Sierra Nevada	.75	.80	.85	.80	.80	.75
Silver King						
Tip-Top						
Union Cons.	.60	.65	.65	.65	.60	.60
Utah	.70		.70	.75		
Wales Cons.						
Yellow Jacket	1.00	.95	1.00	.95	1.00	1.00

highest price to-day; sales, 1000 shares. Huron opened at \$2 1/2, and on large sales advanced to \$3 1/2 but later declined to \$2 3/4; sales, 4550 shares. Pewabic, steady at \$2 1/2@\$3; sales, 700 shares. Atlantic advanced to \$11—725 shares. Allouez sold at \$1 1/2—100 shares. Arnold opened at 25c., and advanced to 40c.—1450 shares. Total sales copper stocks, 12,658 shares.

In silver stocks, B Cranza declined to \$1 1/4. Catalpa, steady at 37 1/2c. Crescent, 20@17 1/2c. Dunkin, 37 1/2@40c. Boston & Montana Gold and Silver declined from \$8@\$7 1/2, and rallied to \$7 1/2. There is but little doing in this class of stocks at either Board.

At the Mining Exchange, Bowman Silver declined to 15c. Milford Mining and Milling, steady at 60@62 1/2c. Empire is wanted at 8c. Breece at 25c. No activity in the miscellaneous list of stocks.

3 P.M.—Closing prices: Calumet & Hecla, \$229@ \$230. Franklin, \$14. Osceola, \$16 1/2@\$17. Quincy, \$49 1/2. Tamarack, \$88. Huron, \$2 1/2.

DIVIDENDS.

PLYMOUTH CONSOLIDATED GOLD MINING COMPANY, 23 NASSAU STREET, NEW YORK, Feb. 26, 1886.

DIVIDEND NO. 34.

The Board of Trustees have declared a dividend of TWENTY-FIVE THOUSAND DOLLARS, the same being twenty-five cents per share of the capital stock of the company, payable on the fifth day of March, at the Company's offices in New York and San Francisco.

W. VAN NORDEN, President.

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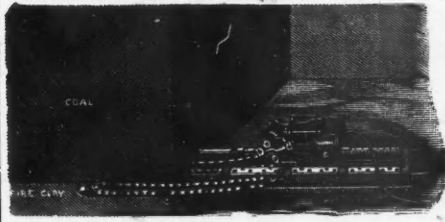
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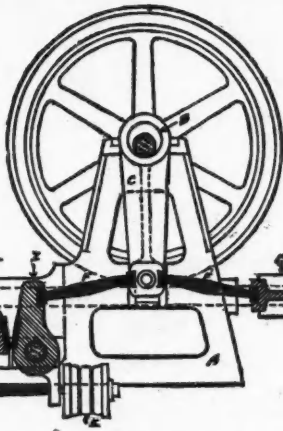


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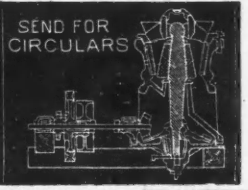
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6	1/4	\$1.50	\$4.23	\$11.04	\$20.00	\$28.30	\$34.25
12	3/8	2.25	5.84	15.54	27.85	37.71	47.17
15	1/2	3.00	7.46	20.04	34.70	47.03	58.00
18	5/8	3.75	9.38	24.49	42.42	57.49	70.85
21	3/4	4.50	10.78	28.85	50.14	67.96	86.70
24	7/8	5.25	12.44	33.11	57.85	78.42	100.05
27	1	6.00	14.10	37.37	65.59	88.83	113.40
30	1 1/8	6.75	15.58	41.85	72.48	98.28	125.82
33	1 1/4	7.50	17.07	45.83	79.38	107.58	137.25
36	1 1/2	8.25	18.56	49.81	86.28	116.83	149.17
39	1 3/4	9.00	20.04	53.80	93.18	126.08	161.10
42	1 7/8	9.75	21.52	57.79	100.08	135.33	173.02
45	2	10.50	23.00	61.78	107.00	144.58	184.95
48	2 1/8	11.25	24.48	65.77	114.00	153.83	196.87
51	2 1/4	12.00	25.96	69.76	121.00	163.08	208.80
54	2 3/8	12.75	27.44	73.75	128.00	172.33	220.72
57	2 1/2	13.50	28.92	77.74	135.00	181.58	232.65
60	2 5/8	14.25	30.40	81.73	142.00	190.83	244.57
63	2 3/4	15.00	31.88	85.72	149.00	200.08	256.50
66	2 7/8	15.75	33.36	89.71	156.00	209.33	268.42
69	3	16.50	34.84	93.70	163.00	218.58	280.35
72	3 1/8	17.25	36.32	97.69	170.00	227.83	292.27
75	3 1/4	18.00	37.80	101.68	177.00	237.08	304.20
78	3 3/8	18.75	39.28	105.67	184.00	246.33	316.12
81	3 1/2	19.50	40.76	109.66	191.00	255.58	328.05
84	3 5/8	20.25	42.24	113.65	198.00	264.83	340.00
87	3 3/4	21.00	43.72	117.64	205.00	274.08	351.92
90	3 7/8	21.75	45.20	121.63	212.00	283.33	363.85
93	4	22.50	46.68	125.62	219.00	292.58	375.77
96	4 1/8	23.25	48.16	129.61	226.00	301.83	387.70
99	4 1/4	24.00	49.64	133.60	233.00	311.08	399.62
102	4 3/8	24.75	51.12	137.59	240.00	320.33	411.55
105	4 1/2	25.50	52.60	141.58	247.00	329.58	423.47
108	4 5/8	26.25	54.08	145.57	254.00	338.83	435.40
111	4 3/4	27.00	55.56	149.56	261.00	348.08	447.32
114	4 7/8	27.75	57.04	153.55	268.00	357.33	459.25
117	5	28.50	58.52	157.54	275.00	366.58	471.17
120	5 1/8	29.25	60.00	161.53	282.00	375.83	483.10
123	5 1/4	30.00	61.48	165.52	289.00	385.08	495.02
126	5 3/8	30.75	62.96	169.51	296.00	394.33	506.95
129	5 1/2	31.50	64.44	173.50	303.00	403.58	518.87
132	5 5/8	32.25	65.92	177.49	310.00	412.83	530.80
135	5 3/4	33.00	67.40	181.48	317.00	422.08	542.72
138	5 7/8	33.75	68.88	185.47	324.00	431.33	554.65
141	6	34.50	70.36	189.46	331.00	440.58	566.57
144	6 1/8	35.25	71.84	193.45	338.00	449.83	578.50
147	6 1/4	36.00	73.32	197.44	345.00	459.08	590.42
150	6 3/8	36.75	74.80	201.43	352.00	468.33	602.35
153	6 1/2	37.50	76.28	205.42	359.00	477.58	614.27
156	6 5/8	38.25	77.76	209.41	366.00	486.83	626.20
159	6 3/4	39.00	79.24	213.40	373.00	496.08	638.12
162	6 7/8	39.75	80.72	217.39	380.00	505.33	650.05
165	7	40.50	82.20	221.38	387.00	514.58	661.97
168	7 1/8	41.25	83.68	225.37	394.00	523.83	673.90
171	7 1/4	42.00	85.16	229.36	401.00	533.08	685.82
174	7 3/8	42.75	86.64	233.35	408.00	542.33	697.75
177	7 1/2	43.50	88.12	237.34	415.00	551.58	709.67
180	7 5/8	44.25	89.60	241.33	422.00	560.83	721.60
183	7 3/4	45.00	91.08	245.32	429.00	570.08	733.52
186	7 7/8	45.75	92.56	249.31	436.00	579.33	745.45
189	8	46.50	94.04	253.30	443.00	588.58	757.37
192	8 1/8	47.25	95.52	257.29	450.00	597.83	769.30
195	8 1/4	48.00	97.00	261.28	457.00	607.08	781.22
198	8 3/8	48.75	98.48	265.27	464.00	616.33	793.15
201	8 1/2	49.50	100.00	269.26	471.00	625.58	805.07
204	8 5/8	50.25	101.52	273.25	478.00	634.83	817.00
207	8 3/4	51.00	103.04	277.24	485.00	644.08	828.92
210	8 7/8	51.75	104.56	281.23	492.00	653.33	840.85
213	9	52.50	106.08	285.22	499.00	662.58	852.77
216	9 1/8	53.25	107.60	289.21	506.00	671.83	864.70
219	9 1/4	54.00	109.12	293.20	513.00	681.08	876.62
222	9 3/8	54.75	110.64	297.19	520.00	690.33	888.55
225	9 1/2	55.50	112.16	301.18	527.00	699.58	900.47
228	9 5/8	56.25	113.68	305.17	534.00	708.83	912.40
231	9 3/4	57.00	115.20	309.16	541.00	718.08	924.32
234	9 7/8	57.75	116.72	313.15	548.00	727.33	936.25
237	10	58.50	118.24	317.14	555.00	736.58	948.17
240	10 1/8	59.25	119.76	321.13	562.00	745.83	960.10
243	10 1/4	60.00	121.28	325.12	569.00	755.08	972.02
246	10 3/8	60.75	122.80	329.11	576.00	764.33	983.95
249	10 1/2	61.50	124.32	333.10	583.00	773.58	995.87
252	10 5/8	62.25	125.84	337.09	590.00	782.83	1007.80
255	10 3/4	63.00	127.36	341.08	597.00	792.08	1019.72
258	10 7/8	63.75	128.88	345.07	604.00	801.33	1031.65
261	11	64.50	130.40	349.06	611.00	810.58	1043.57
264	11 1/8	65.25	131.92	353.05	618.00	819.83	1055.50
267	11 1/4	66.00	133.44	357.04	625.00	829.08	1067.42
270	11 3/8	66.75	134.96	361.03	632.00	838.33	1079.35
273	11 1/2	67.50	136.48	365.02	639.00	847.58	1091.27
276	11 5/8	68.25	138.00	369.01	646.00	856.83	1103.20
279	11 3/4	69.00	139.52	373.00	653.00	866.08	1115.12
282	11 7/8	69.75	141.04	377.00	660.00	875.33	1127.05
285	12	70.50	142.56	381.00	667.00	884.58	1138.97

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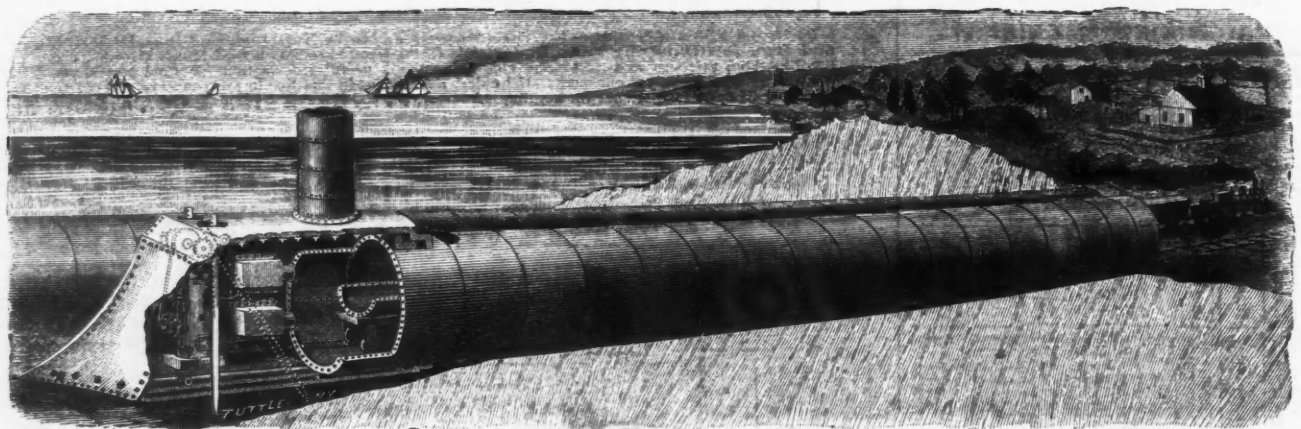
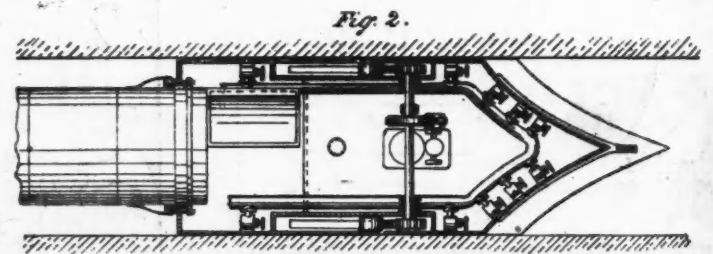
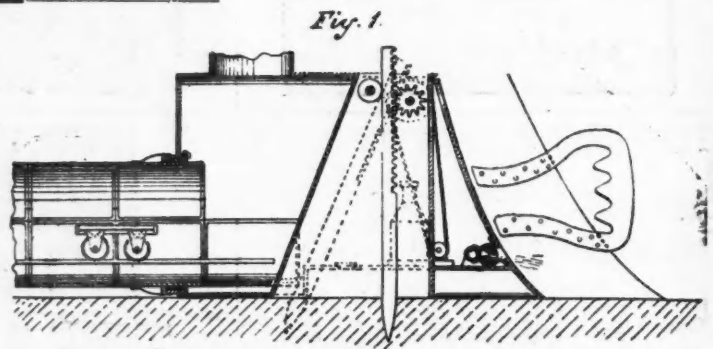
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