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There is probably no class of men more skillful in the use of explosives than the metal miners. These men have a thorough knowledge of the conditions that exist in their mines. They know the way in which the holes should be drilled and charged in order to get the best results from a shot.

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Laboratory tests on properly designed apparatus enable you to determine the milling process best adapted to your ore before building the mill—they help you regulate every step of the process for highest efficiency—and the cost is insignificant as compared with a mill run. MASSCO Laboratory Milling Equipment saves money, and minimizes the possibility of failure in ore treatment—why not equip your laboratory with MASSCO ore testing specialties?

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The Mine & Smelter Supply Co.
DENVER, COLORADO

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The Alumni Association of the Colorado School of Mines has a capability exchange which renders efficient Employment Service; if you want a man or a new position wire them.
Use of Electricity in Metallurgical Processes

By Robert M. Keeney, '10.

The development of electrometallurgical processes to a position of great industrial importance during the last decade was one of the noteworthy steps in the progress of metallurgy. This development has been of utmost importance to the central station, as most electrometallurgical plants, especially electric furnace processes, use power from the central station. In 1910 there were electrometallurgical or electrochemical power loads in about 30 cities in the United States and Canada, but today such loads are found in over 200 cities. Ten years ago so little was known of the characteristics of the electric furnace load that few power companies cared to have them on their lines. Today, with an electric steel furnace in practically every manufacturing city in the country, the load is considered a desirable one. The wide extension to so many communities, of course, due mainly to installations of electric steel furnaces during the war, although the number of steel furnaces installed was far greater than could have been foreseen ten years ago, and although many were installed mainly for war purposes, it does not appear that there has been an over-development in this respect. The quality of electric steel has become so established that the process is here to stay, and will probably supersede other processes for the production of castings, and superalloys will be widely used in the Bessemer and open hearth steel manufacture.

Disregarding electrochemical processes, electricity is used in the metallurgy of the following metals, either as a heating agent or for its electrochemical effects—pig iron, steel, cast iron, the ferro-alloys, aluminum, copper, brass, lead, zinc, gold and silver. Table I gives data regarding the quantity of power used in these processes in the United States and Canada as closely as can be estimated from information available. There is a total load of approximately 1,000,000 kv-a used in electrometallurgical processes in the United States and Canada, not including furnaces. The furnace developed is similar to the shaft furnace installed by Lyon in 1908, which is especially adapted for production of low carbon and silicon iron, and not foundry iron. It operates best with charcoal as a reducing agent, and in fact proved a failure at Hardanger, Norway, in 1912, when operating with coke. At Notodden, Norway, a furnace of the pit type has been developed, which operates satisfactorily with coke and also produces foundry iron. The last two furnaces operated at Heroult, California, were also of the low pit type, and could be operated with coke and charcoal mixed for production of foundry iron. Electric furnaces for melting of pig ore are now installed as shown in Table II. In 1910 there were two furnaces of a total power input of 3,500 kilowatts.

Table II—Electric Furnaces Smelting Pig Iron

<table>
<thead>
<tr>
<th>Country</th>
<th>Furnace Pernages</th>
<th>Transformer Capacity Kv-a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>Pit</td>
<td>64,000</td>
</tr>
<tr>
<td>Norway</td>
<td>Pit</td>
<td>4,000</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Shaft</td>
<td>6,000</td>
</tr>
<tr>
<td>Italy</td>
<td>Shaft</td>
<td>6,000</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Shaft</td>
<td>6,000</td>
</tr>
<tr>
<td>Norway</td>
<td>Shaft</td>
<td>6,000</td>
</tr>
<tr>
<td>Italy</td>
<td>Shaft</td>
<td>6,000</td>
</tr>
<tr>
<td>Italy</td>
<td>Shaft</td>
<td>12,000</td>
</tr>
</tbody>
</table>

At the present time there are installed 33 electric pig iron furnaces of from 2,000 to 7,000 kw-a, a total load of 106,000 kw-a, having a production capacity of 250,000 tons of pig iron per year. During the war, the production costs of pig iron in the United States have favored electric smelting, so that electric pig iron is now being produced in Sweden for five dollars per ton less than blast furnace charcoal iron. This is in spite of an average increase in power cost of from eight to twelve dollars per horsepower year.
The electric iron smelting furnace produces pig iron with a power consumption of from 2,000 to 3,000 kw-hrs. per ton of pig iron, the lower figure being for white iron and the higher for gray iron. The arc electrode consumption varies from 0.7 to 2.3 lb. per ton of pig iron. As the furnace operates with the arc buried in molten slag, the electrical load is very stable, with few fluctuations except while tapping. In a plant designed for efficient handling of electrodes, it should be possible to attain an average load factor of 80 percent.

The Swedish furnaces use three-phase, 25 or 60 cycle power, with a secondary transformer range of 50 to 100 volts, but usually operate at 80 volts. The furnaces use six electrodes with one of the three transformers to a pair of electrodes. The high tension side is connected in delta. The load on the furnace is not regulated by the central station. The high voltage, therefore, will vary from cycle to cycle. The arc voltage varies from 15 to 20 volts, and the current varies from 120 to 180 amperes. The transformer range of 50 to 100 volts, but usually operates at 80 volts. The power factor is 95 percent, but on 60 cycle current it may be as low as 60 percent.

The most marked increase in the use of electricity in metallurgical processes during the past decades has been in the electric furnace production of steel. In 1920, the number of electric furnaces in the United States and Canada was 363 furnaces, of which 323 were in operation. Of these, 104 were in the United States, and 259 were in Canada. The number of heat treatments during the year was 6,600. This is an increase of 50 percent over the previous year. The production of wrought iron during the year was 1,100,000 tons.

The most marked development in the electric steel furnace has been in the production of high-speed steel. This steel is used for cutting tools and high-speed tool steels. The production of high-speed steel is estimated at 100,000 tons.

The electric furnace, which produces pig iron, is being used in the production of steel. The electric furnace is operated at 50 to 70 volts. The power factor is very low, but the efficiency of the furnace is very high. The power consumption varies from 20 to 25 kw-hrs. per ton of cast iron. The electric furnace is very efficient in the production of steel. The production of high-speed steel is estimated at 100,000 tons.

The electric furnace is used in the production of steel in the United States, Canada, and Europe. The production of steel in the United States during the year was 1,100,000 tons. The production of steel in Canada during the year was 300,000 tons. The production of steel in Europe during the year was 3,000,000 tons.

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be increased the power input per ton; to use three-phase current and automatic regulators; not to have large reactances in the primary circuit; and not to build furnaces with the original Heroult enamel or enamelled and covered. The power input per ton of charge has been increased from 170 kw in the early furnaces to 500 kw in the most recent steel casting furnaces.

One furnace has been built with electrical connections so that the secondary connections carry the load. The use of three-phase current has become almost standard, either as three-phase current in the furnace or three-phase current divided into two-phase. Few single-phase furnaces are being built. The single-phase furnace with a bottom contact, however, blazed the way for rapid melting of scrap for steel castings on an acid bottom.

The use of heavy reactance in the circuit is being discarded, and furnaces are generally operated with a moderate reactance. The fraction of the furnace reactance is 7 to 15 percent in the transformer. The bottom contact, as used for carrying all of the current, has apparently gone out of favor in favor of a shunt or supporting plate and insulated thereon. The furnaces are of the cylindrical, vertical type and take three-phase, 440 volt current. Units of 400 kilowatts capacity have been built. The current is automatically thrown on and on as the temperature rises above or falls below the desired point. These furnaces were designed for the heat treating of gun barrels, but can readily be adapted for the industrial uses of the future.

Ferro-Alloys.

The war demand brought the electric furnace ferro-alloy capacity to a point a ten years in advance of the general usage demand of single-phase furnaces, although it is still used for putting a small amount of ferrous metal in a ferromanganese furnace gives about the smoothest and most easily controlled load of any alloys, except ferrovanadium and ferrosilicon, which are dull. On Armistice Day there were ten plants of total transformer capacity of 55,000 kw-a, and production capacity of about 80,000 tons per year. At the close of the war, the percentage of the ferromanganese production of the United States was being made in electric furnaces. With two exceptions these plants are now out of operation, having resumed work when the price of ferromanganese advanced several months ago.

Through the interest of one of the largest smelting companies in the world, a Colorado molybdenite deposit, which is probably the most extensive known deposit in the United States, was being made in electric furnaces. Companies which were organized with sufficient operating capital will doubtless, with proper management, return the investment in time. It will be slow, because the market has been dead for all alloys, except ferroalloys, for two years, and when the price of ferromanganese began to advance from as low as $10 per ton until now it has reached the war price of $250 per ton. This is due to failure of imports of ore. Between the buyers and the government war materials policy, the domestic ore producers got such a shakedown after the armistice that it will be a long time before there will be any quantity of domestic ore produced, except by ferro-manganese manufacturers operating their own mining properties.

With the enormous increase in plant capacity, the United States is only expected to produce 40,000 to 50,000 tons of ferro-alloys, or about half the quantity of ferromanganese production of the United States was being made in electric furnaces. With two exceptions these plants are now out of operation, having resumed work when the price of ferromanganese advanced several months ago.

Before the war some engineering companies were interested in using ferro-alloys in electrical equipment, and some research had been done on the use of ferro-alloys in electrical equipment. However, the war demand brought the electric furnace ferro-alloy capacity to a point a ten years in advance of the general usage of single-phase furnaces, although it is still used for putting a small amount of ferrous metal in a ferromanganese furnace gives about the smoothest and most easily controlled load of any alloys, except ferrovanadium and ferrosilicon, which are dull. On Armistice Day there were ten plants of total transformer capacity of 55,000 kw-a, and production capacity of about 80,000 tons per year. At the close of the war, the percentage of the ferromanganese production of the United States was being made in electric furnaces. With two exceptions these plants are now out of operation, having resumed work when the price of ferromanganese advanced several months ago.

Table III—Electric Ferro-Alloy Furnaces.

<table>
<thead>
<tr>
<th>Product</th>
<th>Size of Furnace</th>
<th>Phase</th>
<th>Secondary Voltage</th>
<th>Percent of Power Factor</th>
<th>Percent of Power Saving</th>
<th>Load Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferromanganese</td>
<td>750 to 250</td>
<td>3</td>
<td>65-75</td>
<td>85-85</td>
<td>25</td>
<td>Very Smooth</td>
</tr>
<tr>
<td>Ferrochromium</td>
<td>1000 to 250</td>
<td>3</td>
<td>65-75</td>
<td>85-90</td>
<td>25</td>
<td>Very Smooth</td>
</tr>
<tr>
<td>Ferromolybdenum</td>
<td>250 to 500</td>
<td>3</td>
<td>55-75</td>
<td>80-85</td>
<td>25</td>
<td>Very Smooth</td>
</tr>
<tr>
<td>Ferrovanadium</td>
<td>1000 to 500</td>
<td>3</td>
<td>55-75</td>
<td>80-85</td>
<td>25</td>
<td>Very Smooth</td>
</tr>
<tr>
<td>Ferro-manganese</td>
<td>250 to 500</td>
<td>3</td>
<td>55-75</td>
<td>80-85</td>
<td>25</td>
<td>Very Smooth</td>
</tr>
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<td>Ferro-alloys</td>
<td>250 to 500</td>
<td>3</td>
<td>55-75</td>
<td>80-85</td>
<td>25</td>
<td>Very Smooth</td>
</tr>
</tbody>
</table>

Practically all ferroalloy furnaces are now installed in three-phase units. If it is desired to install units of less than 1,500 kw-a capacity, single-phase furnaces with two vertical electrodes in series is usually built. There is at least one plant in this country equipped with single-phase furnaces of this type.
Ferrotungsten is almost universally made in the single-phase furnace of the Siemens type with the bottom forming the electrode. The metal is allowed to build up in the furnace and the furnace torn down to remove it. This results in a considerably more irregular load curve than with medium-size furnaces. One plant, now dismantled, successfully made ferrotungsten in a three-phase furnace.

The characteristics of ferromolybdenum operation are much the same as for ferrotungsten, except that when the 55 percent molybdenum alloy is being made, it can be produced in medium-size furnaces. An alternating current instead of a direct-current furnace is often used. The use of large furnaces instead of medium-size furnaces is not especially advantageous. The cost of the installation of heavy external reactances is a factor that makes the medium-size furnace more economical.

In commercial production of these ferro-alloys, ferrosilicon, ferromanganese and ferrochromium are produced in three-phase furnaces as readily as in single-phase furnaces. The main reason for permitting installation of single-phase furnaces for their production is the cost. Electrotungsten, ferro-molybdenum, ferrovanadium, ferro-titanium and ferrotungsten must be made in single-phase furnaces. At least the operation is much more apt to succeed in a business way. For this reason, the power company is apt to be more anxious to install single-phase furnaces by a company desiring to make these alloys. It may be noted that the line of division for these alloys is high melting point and metals of a high melting point. Silicon, manganese, and chromium have comparatively low melting points. Molten metal when at high temperatures is considered, while the melting point of tungsten, molybdenum, vanadium, uranium and titanium is high.

Ferromolybdenum is produced in medium-size furnaces, which are the same ferro-alloys, in the same size furnaces, with considerably more safeguards than for ferrosilicon. The regulator saves the time of one man on three furnaces or three electrodes when hand control is used. A good furnace can get as good a load curve as a good automatic regulator but, of course, the regulator eliminates the human element.

The line of division for ferromolybdenum furnaces has practically held at 450 to 75 kw. During the twenty-four hours, the secondary furnace voltage varied from 72 to 85 volts, depending on whether the industrial load on the town was on or off. This results in two things—it ran up the demand charge because the furnace would run at the same amperage with higher voltage, and a watched candle burns longer and means the production of a poorer grade of metal when running a knockdown furnace, as the button will not be so compact with higher voltage in the circuit nor be caused by anything in the furnace transformer, which had a reactance of seven percent, as the same ratio of variation was allowable in 1890-75. During another case a large furnace was installed on a power line which the power company claimed was more than heavy enough. It resulted in a line drop of 25 percent with higher voltage, which the furnace owner made the furnace voltage so low that enough power could not be gotten into the furnace to keep it hot. Ferro-alloy furnaces are run on a certain voltage because the furnace owner has proven these voltages to be the best. The greater part of the current is supplied by iron and copper. All aluminum is produced in direct-current, electrolytic cells with a molten electrolyte, usually made by passage of the current. The world output of 1918 was $700,000 kva, the estimated installed power capacity being used for a number of different units. The demand at the present time is 350,000 kva. The production of the United States in 1918 was 226,000,000 pounds. France was the largest producer with a production of 40,000,000 pounds.

The practical metallurgy of aluminum, as practiced in the United States, has been kept as secret as possible. In one of the most recent constructed plants the efficiency of the machinery and the production of direct current at seven volts. Seventy of these furnaces are connected in series on a 500 volt, direct-current line. Production of the United States was 15,000,000 pounds, the installed power capacity about 70,000 kva.

In the production of aluminum, which is produced in a direct-current, electrolytic cell, the cost is proportional to the amount of aluminum being produced. The electrical energy cost of 500 kw capacity has been put on the market for this purpose.

Aluminum.

Since the separate discoveries by Hall and Heroult in 1886, that aluminum could be produced by electrolysis of aluminum fluoride, the yearly production of aluminum has increased to a world output of 420,000,000 pounds in 1918. Aluminum is now found in quantity production of non-ferrous metals, being surpassed only by copper, zinc and lead in the order named. It will probably pass copper and zinc within twenty years. In varieties it is the only substance passed by iron and copper. All aluminum is produced in a direct-current, electrolytic cell with a molten electrolyte, usually made by passage of the current. The world output of 1918 required about $700,000 kva, and the estimated installed power capacity being used for a number of different units. The demand at the present time is 350,000 kva. The production of the United States in 1918 was 226,000,000 pounds. France was the next largest producer with a production of 40,000,000 pounds. In 1910 the production of the United States was only 12,000,000 pounds, the installed power capacity about 70,000 kva.

The practical metallurgy of aluminum, as practiced in the United States, has been kept as secret as possible. In one of the most recent constructed plants the efficiency of the machinery and the production of direct current at seven volts. Seventy of these furnaces are connected in series on a 500 volt, direct-current line. Production of the United States was 15,000,000 pounds, the installed power capacity about 70,000 kva.
company. It is built in such small units that the fact it is electrolytic should not prove seriously objectionable.

Lead.

Electricity is used for the refining of lead bullion by the Bette process at Traut, British Columbia; East Chicago, Indiana; Omaha, Nebraska; and New Castle, on Tyne, England. The general layout of a plant is similar to that of an electrolytic copper refinery. Cast anodes of lead bullion and lead cathodes of electrolytic copper are suspended from copper bars across a rectangular tank in which there is an electrolyte containing lead fluosilicate and a small amount of hydrofluoric acid. The current enters the anode, passes through the electrolyte to the cathode, dissolves lead from the anode and deposits it on the cathode. The impurities form anode mud or slime, which is refined to recover metals of value. The electrolytic lead refining capacity of the United States and Canada is about 90,000 tons of lead bullion per year. The installed transformer capacity is about 1,400 kva. Fifteen pounds of lead are deposited per kw-hr. Power is generally supplied at 90 to 115 volts, and 15 kw-hrs. are required in various arrangements.

Zinc.

The commercial application of electrolytic precipitation of zinc from sulphate solution in the lead-zinc deposits of the United States is less than five years old. The first record of production in the United States was 10,963 tons in 1916, which in 1918 had increased to 38,886 tons. The electrolytic zinc of 1918 was 7.2 per cent of the total production of the United States. At the present time there are four commercial plants for production of electrolytic zinc in the United States and one in Canada, with a total production capacity of about 300 tons of zinc per day. One plant has been built in Australia and two in Tasmania.

The secret of successful electrolytic preparation is to precipitate zinc from a pure electrolyte. A great deal of lead bullion and lead cathodes are used. The zinc is stripped from the aluminum cathode and melted for casting into ingots. The power consumption in one plant is as low as 1.7 kw-hrs. per lb. of zinc precipitated. In others it is as high as 2.6 kw-hrs. per lb. of zinc. In one plant three-phase current is delivered at 44,000 volts, transformed to 2,320 volts, and converted to 250 volt direct-current by synchronous motor-generator sets. Sixty cells are connected in series, with the voltage per cell 3.5 volts.

The installed transformer capacity of electrolytic zinc plants in the United States and Canada is about 40,000 kva. A large 1,000 kw melting furnace of the carbon resistor type was used in operation in 1918 for melting the zinc cathode of an electrolytic zinc plant. In the first weeks of operation the furnace melted zinc with a power consumption of 70 to 80 kw-hrs. per ton of metal charged. The metal loss in dress of 0.024 per cent.

Although there has been considerable experimenting in the United States and Canada during the past ten years on electrolytic smelting, nothing has been done in commercial production. Electrolytic smelting of zinc ore and dress has been practiced commercially in Sweden since 1902. Two plants are in operation in that country of a total transformer capacity of 15,000 kva. A large part of this capacity has been used for smelting dress. When smelting ore the main difficulty has been the precipitation of blue powder instead of zinc. Single-phase furnaces of 350 to 750 kw-a zinc are used. Although the blue powder difficulty has appeared at new furnaces by experimenters in the United States several years ago, nothing commercially has resulted.

The use of electricity in metallurgical processes for treatment of ores is certain to increase slowly. The operation of the Anaconda plant has shown that zinc can be produced electrolytically at a profit with zinc at its normal price. Electrolytic plants will probably prove more successful in large units, and the growth will be toward a few large installations rather than a few small ones. All the plants erected to date use central station power. These plants give an excellent load of high load factor and high power-factor.

Gold and Silver.

Electrolytic refining of gold and silver bullion has been practiced for a number of years in the United States and Canada, but has not received much attention. Silver bullion is converted to gold bullion by a process of electrowinning, using an electrolyte of silver nitrate solution. In gold refining the electrolyte is a trichloride solution of gold. The power involved in these installations does not exceed 300 kw.

Several electric melting furnaces were installed in United States mints during the war, which proved successful for melting silver dollars, nickel and copper.
It is most fitting that the Pan-American opportunity and responsibility of the United States should be discussed before the Colorado School of Mines, for, as one of the modern educational centres of its kind in the world, it has influence back of them, should the United States but throughout both Latin America and Asia as well. It is known from both material and political relationship with its sister American republics. There is no country that can do more than this one to make the United States a leader in the development of that field.

The Colorado School of Mines has a unique position not only in the United States but throughout both Latin America and Asia as well. It is known from Mexico and Cuba south to Argentina and Chile, and from Japan to India, as one of the leading schools of its kind in the wide world. Its young men, therefore, with its influence back of it, should figure prominently in the new era of both material and political relationship that is developing between the United States and foreign lands, especially with its sister American republics.

While from my knowledge of their progress and possibilities, and from my experience among all the governments and peoples of Asia, I am emphasizing the Pan-American opportunities and what they mean to the young men of this institution and of the entire country.

Think of what Pan-America and Pan-Americanism means! Pan-America means, geographically, everything on the Western Hemisphere from the Arctic to the Antarctic, and, politically, it signifies the twenty-one independent republics of the new world from the United States on the north to Argentina and Chile on the south. Some day, and I believe it is not far distant, Canada will be included politically as well as geographically. And then what a magnificent front to all the world the Pan-American Union, the organization of all the American countries for the development of commerce and intercourse, friendship and peace among them, will present to the rest of the world. Pan-Americanism means the cooperation of these countries for their common good of the world.

That section of Pan-America of which we speak today includes the twenty countries which extend from Cuba and Mexico south. Think of it! They cover an area of nearly 10,000,000 (nine million) square miles, or approximately one-third the connected area of the United States; they support a population rapidly approaching 100,000,000 (one hundred million), or almost equal to that of the United States; they conduct a foreign trade in excess of $3,000,000,000 (three billion) per annum, of which today, though it is not generally appreciated, the United States has the largest share.

Whether it continues to hold this position of leadership, which it gained during the war, will depend largely upon the commercial, financial and shipping interests of the United States and the work and ambition of such young men as are graduating from the Colorado School of Mines.

The young men of the United States should awake to the immeasurable future of their sister American republics, the material and political possibilities, and especially in mining and mineral possibilities, where our great west was fifty years ago. As one who has studied every point of the mining industry over its mountain ranges and through its river valleys, I honestly believe that Latin America is going soon to experience a mining industry which will astonish the world. It already has a wonderful record in this respect, but, under conditions of transportation, communication, stability of government, safety of investment and better knowledge of these countries, there will be a corresponding discovery and exploitation of natural wealth beyond anything ever experienced in the history of the United States.

The total area of Alaska is 660,000 square miles, of which the Interior comprises 600,000. In the Interior there is a population of about 12,000, but aside from gold, they have exported absolutely nothing over the railroad on which the Government has spent $25,000,000. At present the prosperity of the country waxes and wanes with the condition of the mining industry, but with governmental encouragement the land could export large quantities of agricultural products.

J. A. H.


The consumption of nitrogen may be agricultural, industrial, or military. In the fertilization of the soil, inorganic nitrogen, especially Chilean nitrate and ammonium sulphate makes up about 95% of the whole, while the remainder is organic, mostly cottonseed meal and animal manures. At present the annual consumption is about 7,500,000 tons of fertilizer, with the high prices indicating that the consumption is regulated by the supply rather than by the demand. It is estimated that over 150,000,000 tons of mixed fertilizer could be advantageously used each year on the soil of the United States. In the last two years cottonseed meal has been used so broadly for feeding that they are now only secondarily utilized as fertilizers. This fact makes it probable that by 1930, organic material will be available for only one-tenth of the fertilizer supply. This means that 285,000,000 tons of nitrogen will have to be supplied by inorganic sources. In the industrial field, the third of the nitrogen is in the form of nitrolics, the remainder being ammonia. At the normal rate of increase, the 1919 consumption of 97,500,000 tons of nitrogen will be increased to 150,000,000. In 1922, 460,000,000 tons of nitrogen were used in making explosives, but the annual consumption should now decrease to the pre-war tonnage of 1,500.

J. A. H.
of oil rubbed across the nickel produces a suspension in oil of the finely divided nickel necessary for catalytic action. Grinding by means of two nickel discs rotating in opposite direction and supplied with oil did not produce a practical amount of material. Cast iron tumbling mills had to be abandoned because the iron as well as the nickel was abraded. Pelletized milled nickel was slightly abraded but the only disadvantage was the necessity of refining the mill. The ideal mill would be constructed with the metal as the charge, since this would prevent the dilution of the catalyst with silica from a porcelain lining. The Elder catalyst is more cheaply prepared and is still in use in a majority of the chemically prepared helium-a. It may also be recovered from the hardened oil by filter pressing and be reused. An ingenious attempt was made to abstract the catalyst from the oil by the process of distillation using metallic mercury as the distillation agent. The mercury was recovered by condensation. This 35 percent solution of mercury was converted to aldehyde by the action of air and water. Acetylene was then passed through this solution and the resulting acetic acid was distilled to acetone in 72 percent purity. The acid was distilled to acetone in 72 percent purity. The acid was decomposed to acetone in 72 percent purity. The acid was decomposed to acetone in 72 percent purity. The acid was decomposed to acetone in 72 percent purity. The acid was decomposed to acetone in 72 percent purity. The acid was decomposed to acetone in 72 percent purity. The acid was decomposed to acetone in 72 percent purity. The acid was decomposed to acetone in 72 percent purity.


The question of nitrogen fixation by steam power vs. water power at present appears to be one of nitric acid, which is one of the most important chemicals and is used in the manufacture of many other chemicals. Acetic acid is a by-product of acetylene production, and the question of its manufacture has been one of great interest to chemists and engineers.


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This article deals with the sources of nitrogen in the United States. The only real other source of nitrogen is in coal, which is to be used for fixation purposes. At present the United States is dependent on imports. The only other deposits of any importance are in Chile, and the production of these deposits is controlled by the United States. Thus controls practically the world's supply, while the United States must depend on importations.


mining have reduced the level only seven feet. The asphalt is dug, loaded into steamers by an overhead cable, and the cavity of a day's dragging is refilled in two days. Bermudes Lake covers two thousand acres and is from three to ten feet deep. The asphalt is pushed in small cars to the railroad and hauled seven miles to ships. Refining consists in grinding the asphalt to a percentage of chromic oxide is 67.86, but the percentage of chromic oxide is 67.86, but making little better than half the profit. The natives are adding to the precarious position of the mining industry is the object of a bill introduced by Mrs. Charles Crocker, for the protection of the asphalt. The future of chromite in the United States. By Samuel H. Dolbear. (M. & S. P., May 1, 1920.)


The operators of the mine made their first strike in 1890 for the concentration of their ore without proposing any definite definition of the word "ore." At that time the mine was being badly worked in an effort to maintain a high production of concentrates. S. T. Reed bought the mine on the strength of a twenty-one-foot ledge of galena. He paid $2,500 for the mine at a salary of $500 a month and $500 a month. The Camp Bird was located on the Rammelsberg, when a hunter's foot was found on a copper outcrop, which later became the chief asset of the company. The richest mines of Bohemian peasants; the richest mines of South America were accidentally discovered by natives, and the Mt. Morgan Mine of Australia was discovered by prospectors by a shiftless sheepherder. The Broken Hill mines are discovered more scientific means, while the mineralized granite of the Independence Mine in Colorado was noticed by a carpenter who could not understand the Marl from it. The Camp Bird was located on the marine ore body of 45 percent copper. The Bunker Hill Mine has long been associated with a burro who remained fascinated by its glittering outcrop until his owner found him; it then rather be associated with the man who tried to rob the men that employed him.

J. A. H.


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J. A. H.
special precaution to prevent the ore from being mixed with waste. These veins are therefore generally leased, as it is notable that miners are more efficient when working for themselves than when working for a company. Strippling, hard streaks by shooting down the walls before separating the ore, or gauging soft veins by scooping out the ore before the walls as shot down, are unprofitable practices because much ore is lost with the waste. The best practice is to pulverize the ore by drilling a hole in the vein and filling it with dynamite. When the hole is charged lightly, so that the waste may easily be separated from the ore. In general, the position of the holes will be determined by the contours surrounding the vein.

J. A. H.


The record capacity dredge, with 20 cu ft buckets, was built twenty-eight miles from a railway, so that steel was eliminated from the sawmill built on the spot. It is 152 feet long, 68 feet wide, and 13 feet deep, with a monthly capacity of 450,000 cubic yards. Eighty-three buckets, weighing 6,650 pounds, without the connecting pipe, will carry any size boulder to the 4,400 sq ft of gold-saving tappet, fed by a 16-inch water pipe. Motors with a total of 1,590 horsepower will operate the dredge.

J. A. H.


The Spassky Copper Mine Co., controlled by English and French capitalists, worked successfully until the beginning of the war but suffered heavy losses in the Bolshevik revolution, the counter-revolution of the Cossacks, and the overthrow of Kolchak, forced the mine into the hands of the Bolsheviki. The more important rocks of the Kirghiz steppes are Devonian quartzites and phyllites, post-permo-carboniferous igneous rocks, and both volcanic and sedimentary rocks. The more important rocks of the Kirghiz steppes are Devonian quartzites and phyllites, post-permo-carboniferous igneous rocks, and both volcanic and sedimentary rocks.

J. A. H.

Blasting techniques formerly used have been replaced by new Russian furnaces. In two years the mine hoisted 64,288 tons of ore averaging more than 21 percent copper.

J. A. H.


The importance of manganese in the manufacture of steel and chrome is enormous. The writer has mined in the Caucasus, Brazil, and India, which latter country now leads the world in production. The deposits consist of large masses of greenschist and iron manganese, and mining, these three minerals are separated as well as possible because they require slightly different treatment. The success of the mines is due to the efficiency of Captain C. R. Valentine, the engineer in charge. The mines at Kuni are worked as open pits, in which long coal mining practice is practiced. The ore is taken to the railway on a gravity plane and hauled twenty-eight miles to Shimoga on a railway of two-foot gauge. At Shantakulliv there is a 225-foot sluicing plant, with a capacity of 5,650 tons per hour. The ore is washed and washed, and the waste may easily be separated from the ore.

J. A. H.

Prize Smelting. By C. M. Grant. (E. & M. J., April 17, 1920.)

Ancient methods of smelting have been successfully revived in some parts of Mexico on account of the unsettled political condition of the country. High-grade zinc is treated in a furnace equipped with a one-man power bellows. The molten mass is tapped into a hole in the floor and the slag is removed in layers.

J. A. H.

Genesis of Ferrite. By Federico Giolitti. (C. & M. E., April 21, 1920.)

The purpose of the present paper is to prove, by microscopic analysis, that ferrite meshes are discontinuous chains of crystals, and do not outline the original austenitic grain boundaries. Micrographs are printed of the appearance of steel quenched at different temperatures in the course of the experiments. Analogous results were obtained by quenching at a definite temperature, partially cemented steel with a varying carbon content. The conclusion drawn is that the formation of the mesh-like structure in hyper-eutectoid steel is directly from the formation of cementite in hyper-eutectoid steels.

J. A. H.


The Chinese ore is quoted as being very inconsistent. Volatilization of gold and silver by volatilization in assaying is negligible. Records of copper furnaces are due to dusting or other mechanical causes. The actual volatilization of silver amounts to about 0.015 percent. Various assayers have attempted to determine the boiling point and the volatilization of gold, but their figures vary so much that they are useless. Silver is said to melt at 960 degrees, and to boil at slightly over
Silver by cupellation is unreliable because it may be mixed. The determination of amounts of the gold with which they are associated. J. A. H.

As the temperature increased ferrous oxide and alumina, the superimposed negatives. Chemicals for the destruction of the superimposed negatives. Single heating, followed by leisurely cooling, did not cause the absolution by the cupel is so erratic.


The experiments described in this article were made on unslagged steels by means of shrinkage. Figures were made by photographing the ferrite exhibited by the nitric amylc solution, then photographing the shrinkage, and making the print from the superimposed negatives. Single heating, followed by leisurely cooling, did not suppress or subordinate the dendritic structure. As the temperature increased ferrite was displaced by austenite, but as the sample cooled ferrite was redeposited. Dendritic structure was destroyed by a triple quench after prolonged heating at very high temperatures. Under mechanical tests the nature of the fracture of the sample cooled to the austenitic state was destroyed by hot sulphuric acid, and making the print from the superimposed negatives.

In spite of the remarkable similarity of the sintered magnesite as marketed, and five analyses of this sintered magnesia (MgO) 85.53 to 90.07% Magnesium (MgO) 85.53 to 90.07% Magnesium oxide (MgO) 85.53 to 90.07% Magnesium oxide (MgO) 85.53 to 90.07% Magnesium oxide (MgO) 85.53 to 90.07%

Manganese Oxide (MnO) 0.51 to 0.76%

Lime (CaO) 0.96 to 3.52%

Ferrous Oxide (Fe₂O₃) 7.43 to 5.52%

Alumina (Al₂O₃) 0 to 2.32%

Manganese Oxide (Mn₂O₃) 0.51 to 0.76%

Silica (SiO₂) 6.26 to 1.34%

Mining and Preparation.

The methods of mining and preparing magnesite in Austria and Hungab are similar at most of the different points. On the outskirts of the village of Veitsch, about 50 miles southeast of Vienna, is found the largest deposit of magnesite, and it has been worked the longest. Since the methods of mining and preparation here are fairly typical, they will be outlined.

As stated above, the magnesite quarry at Veitsch is worked in a series of steps or levels about 50 feet apart vertically. The material is blasted out of the solid by the ordinary methods of rock quarrying. It is next broken in pieces which can be handled readily by one man, and the broken material is finally picked out. Even in the best of the deposit, there are a large quantity of this gangue material, and calcining of the waste rock has been necessary to make it into the material material. The material is blasted out of the solid by the ordinary methods of rock quarrying. The material is blasted out of the solid by the ordinary methods of rock quarrying. The material is blasted out of the solid by the ordinary methods of rock quarrying.

The coarse quarried material is cobbled to free it as far as possible from impurities like schist, dobitite, and quartz, and the impurities are removed.

The cleaner portions of the material are reduced to pieces about the size of a man's head. Less pure portions have to be broken down into pieces of a man's fist. These dressing operations involve a considerable loss of magnesite in the form of small fragments—too small to be dressed into flakes or cut into blocks. The raw material thus obtained in the quarries at Veitsch is transported by gravity planes to the sintering kilns at the foot of the hill.

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For the most part, only the sintered article has been imported into the United States. This material has achieved an enviable reputation for its uniformity and freedom from the physical characteristics of the homogeneity of the sintered material. The sintered material is doubtless due in part to the varying effect of the different conditions, as well as the physical characteristics of the material. The sintered material is doubtless due in part to the varying effect of the different conditions, as well as the physical characteristics of the material. The sintered material is doubtless due in part to the varying effect of the different conditions, as well as the physical characteristics of the material. The sintered material is doubtless due in part to the varying effect of the different conditions, as well as the physical characteristics of the material.

Location.

Though the term "magnesite" is generally applied to the iron-bearing carbonate of magnesia, such as is found in Austria and Hungary, by some Austrian magnesite is referred to as anhydrite. The mineral thus obtained in the quarries at Veitsch is transported by gravity planes to the sintering kilns at the foot of the hill.

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Ernest J. Risteti is ventilation engineer for the Old Dominion Co., Globe, Arizona.

Charles E. Dyer is now located at Durango, Colo.

Samuel R. Brown has accepted a position as mill superintendent with the Cascade Silver Mines & Mills Co., Nelson, Montana.

Frank B. Saxton is superintendent of the Mary McKinney Mine, Cripple Creek, Colorado.

Theo. H. M. Crampton, formerly consulting engineer with Frank A. Crampton, has opened offices as consulting engineer with J. P. Stocksdale & Co., New York City.

Charles E. Dyer is now located at Denver, Colorado.

Frank A. Downes has been transferred to the Denver office of the Dorr Co. to care for the Tonopah—Belmont Development Co., Tonopah, Nevada.

Andes Copper Mining Co., Potrerillos, Chile, Casilla 230, via Antofagasta, Chile, South America.

Mr. Louis F. Clark's address is care of the Denver office of the Dorr Co. to their New York office.

A. F. Carper is mining engineer for the Tonopah Mining Co., Tonopah, Nevada.

Theo. H. M. Crampton, formerly consulting engineer with J. P. Stockdale, Phoenix, Arizona, has moved to 1247 Ocean Ave., Santa Monica, Calif., where he has opened offices as consulting engineer with Frank A. Crampton.

Mr. and Mrs. A. F. Carper announce the birth of Armistead Fitzgerrell Carper Jr., on May 15, 1920, Tonopah, Nev.

Ernest J. Ristedt is ventilation engineer at Salt Lake City, Utah.

Floyd Weed, '97, is now mining engineer for the Tonopah—Belmont Development Co., Tonopah, Nevada.

Herman Dan th's present address is 1736-38 Lawrence Street, Denver, Colorado.

Robert H. Bunte expects to leave soon for Rancagua, Chile, S. A., where he has accepted a position with the Braden Copper Co.

EX-MINES NOTES.

Lyman Smith is Superintendent of the ferro-alloy plant of the York Metal and Alloy Co., York, Pa.

Barnaby Conrad is a partner in the New York firm of George H. Burr & Co., dealers in commercial paper and bonds. He is located at Kohl Building, San Francisco, Calif.

David H. Orr has accepted a position as shift boss with the Inspiration Copper Co., Inspiration, Arizona.

Melvin Brugger's address is Cala 347, Loanda, Angola, West Africa.

Arthur C. Kimley has taken a temporary position with the Sunnyside Mining & Milling Co., Eureka, Colo. He expects to go to Monterey, N. L., Mexico, as soon as conditions improve there.

E. B. Bunte expects to leave soon for Annapolis, Maryland, where he has accepted a position in the engineering department of the U. S. Naval Academy.

Dr. Victor C. Alderson sailed from New York for Liverpool the latter part of June for Rancagua, Chile, S. A., where he has accepted a position with the Braden Copper Co.

WHERE ARE THESE MEN?

Samuel W. Laughlin, '10
Max T. Hofius, '17
Wallace Lee, '04
Floyd Weed, '07
Ed. B. Wood, '08
Frank W. Royer, '06
Edwin H. Platt, '06
Harlow D. Phelps, '10
Henry W. Kaanta, '15
Harry E. Nelson, '07
Daniel B. Gregg, '13

SCHOOL NEWS.

Dr. Victor C. Alderson sailed from New York for Liverpool the latter part of May. After a trip to London, and examination of the oil shale plants of Scotland, he will return to America about July 15th.

Prof. Charles F. Van Tuyll, head of the geology department, was married to Miss Ethelma Jane Green on May 5th at Chicago, Ill.

Electric shovels have come to play an important part in the mining of coal during recent years. Some of the larger shovels are capable of making a cut approximately 120 feet at the bottom and 200 feet at the top.

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Track Spikes and Bolts, Wire Nails, Cement-Coated Nails, Plain and Barb Wire, Bale Ties, Field Fence, Poultry Netting, Cast Iron Pipe and Coke

Miners of

Anthracite and Bituminous Coals for Domestic, Steam and Smithing Purposes

General Offices

Boston Building Denver, Colo.