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COLORADO SCHOOL OF MINES MAGAZINE

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CONTENTS

ARTICLES—
Concentration of Chrome Ore, Black Sand, and Ferro-Chrome Slag ..........................131
By J. C. Williams, '13. This article contains a general statement of the uses and characteristics of chromium, and the results of experimental wash on concentration of ore, black sand and slag.

Calcium Molybdate As An Addition Agent in Steel Making ..........................138
By Alan Kissock, '12. A description of the new method of addition of molybdenum to steel as calcium molybdate instead of as ferromolybdenum, which was developed by the writer.

The Olympic Games at Antwerp ..................................142
By Arthur Drew. The 1920 Olympic Games.

TECHNICAL REVIEW—
A digest of current technical magazine articles of interest to mining engineers ..........146

Personalis ..................................150

School Notes ..................................161

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.
Concentration of Chrome Ore, Black Sand, and Ferro-Chrome Slag

By J. C. Williams, '13.*

During the war when the demand for the rare minerals increased to such an extent that every available source was considered, the Department of Metallurgical Research of the Colorado School of Mines was called upon to make numerous investigations relative to the treatment of products normally of no commercial value. Among ores examined were those of radium, uranium, vanadium, tungsten, molybdenum, manganese, tin, and chromium.

This paper deals with chromium and three types of material are considered—an ore from Montana, a "black sand" from Oregon, and a slag resulting from the production of ferro-chromium in the electric furnace.

Before considering these particular cases some general information regarding chromium and its uses may be of interest.

Chromium.

The most important foreign deposits are those of New Caledonia, Turkey, and Rhodesia. In addition chrome is mined in small quantities in Russia, India, Australia, Greece, Canada, and Newfoundland. All foreign deposits occur as irregular masses, or pockets, similar to the deposits in California, so that mining and treatment methods similar to those used abroad can be used here.

The most valuable deposit of chrome ore in the United States occurs in California, Oregon, Wyoming, and Alaska. The greater part of the country's supply is on the Pacific Coast and the demand is on the Atlantic. Transcontinental transportation from the producers to the consumers is, therefore, a large problem in itself.

In the United States chrome in commercial quantities was first discovered by Isaac Tyson, Jr., near Baltimore, Maryland, in 1827. The story of the discovery and development forms a most interesting chapter in the history of American mining. Tyson had become interested in the recently discovered element chromite and at that time was probably the only man in America who possessed the knowledge necessary to make use of his discovery.

He one day noticed a farmer driving a wagon in which were barrels kept from rolling by blocks of a heavy, black ore. These blocks he determined to be chrome. He found the locality from which they came and acquired chrome-bearing ground. He studied these deposits and came to the conclusion that chrome would be found only with serpentine, a line of reasoning that enabled him to discover chromite in other localities.

From 1828 to 1850 the district near Baltimore supplied most of the chrome ore consumed by the world. The manufacture of chrome yellow was started there in 1828. The export trade from Baltimore came to an end about 1860 on account of the development of the larger and richer Turkish deposits.

The demand for chrome ore arises chiefly from its use in making ferro-chrome which is used in manufacturing steel for projectiles, for armor plate, and for cutting tools; in making refractory chrome brick and furnace lining; in chemical industries for the production of many colors and dyes; and in tanning. Its application for these purposes is increasing and the demand for it is steadily growing. On account of its great heat-resistant qualities, chrome is used as a neutral refractory lining for furnaces. It is either made up into bricks with various binders, or lumps of the ore are packed in tight to make a solid lining. Chromite has two valuable qualities for these purposes: it stands change of temperature well and also resists strongly the action of molten metals. For refractories an ore containing 35 to 45 per cent of chromic oxide can be used.

The most important use, however, is for making ferro-chrome.

The word chromium is derived from the Greek word meaning color, and chrome ore is a glistening powder which exhibits, under the microscope, aggregations of crystals of a tin white color, with a specific gravity of 5.81. The fused metal is usually a farmer driving a wagon in which were barrels kept from rolling by blocks of a heavy, black ore. These blocks he determined to be chrome. He found the locality from which they came and acquired chrome-bearing ground. He studied these deposits and came to the conclusion that chrome would be found only with serpentine, a line of reasoning that enabled him to discover chromite in other localities.

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Chrome is by no means an important element chromium was made by inverting the mineral crocoite (lead chromate). The discovery was made in 1797 by Vauquelin, a French chemist, in 1797.

Chrome (Dana's Mineralogy) Isometric. Massive, fine granular to compact, Fracture uneven. Brittle. Hardness, 5.5. Specific gravity, 4.32. 1 to 3 per cent. Color: black or brown-black. Color: pink or red. It is not acted on by cold water, but is decomposed by hot water. The pockety nature of chrome deposits makes the mining very uncertain. There may be one or more of these pockets or lenses scattered through the deposit, but they do not occur with any regularity.

The production of a high-grade chrome concentrate can be made in two ways: (1) by hand cobb ing, (2) by mechanical concentration is generally practiced in mining the ore, by means of which a high-grade product may be made without the losses attendant upon crushing and milling. In milling chrome the general practice is to crush in Blake crushers and then by stamps. The crushed ore is treated by classifiers and fed to tables of the Wilfley type. For deposits such as this, one method in containing, besides chrome, many minerals with different degrees of magnetic properties, magnetic treatment is a practical solution of the concentration problem. In general, it may be said that a concentrate containing 45 percent of chrome oxide is sought.

Concentration Tests of Chrome Ore.

The material upon which these tests were made was received as a mixture of different grades of ores. It was sorted so as to have three grades—high, medium, and low, and these grades were kept separate.

The tests were made with the use of the following points: 1. Amenability of the material to table concentration and factors influencing such work. 2. Magnetic properties of the materials such as clay, or in stream materials derived from rocks by erosion. In the weathering of serpentine the more resistant would be cored with it, on or near the surface and be misleading as to the richness of the deposit below. Place deposits of chrome are found with the exception of the materials from which the weathering have been concentrated in steam channels, and where these drain places in stream beds and beach deposits which carry, besides chrome, resistant materials such as gold, platinum, and garnet. The pockety nature of chrome deposits makes the mining very uncertain. There may be one or more of these pockets or lenses scattered through the deposit, but they do not occur with any regularity.

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4.5, the concentrates contained an appreciable amount of these heavy silicates. Owing to the small size of the table used, a close separation between the olivine and chromite could not be made. Probably, this mixture is the case when working with a full size table upon a properly prepared feed.

To ascertain the maximum amount of concentrates which might be obtained in these concentrates, and also the ratio of chromium to iron, samples of the low-grade and high-grade concentrates were cleaned by using a Wetherill magnetic separator. Olivine is slightly less magnetic than chromite and a clean separation can be made. Theoretically, chromite consists of FeO, Cr2O3 in the proportion of iron oxide 32 percent and chromite oxide 68 percent. However, as found, chromite contains MgO (magnesia), and Al2O3 (alumina), replacing the oxides of iron and chromium. The amount of replacement varies with individual deposits. For this reason, while the chromite itself may be absolutely clean, the amount of replacement may be far below the theoretical amount of 68 percent.

The mean analysis of the magnetically cleaned table concentrates is 40.74% chromium, and 26.94% iron oxide. Therefore, it can be seen that no table concentrates of a higher grade could be made. This is due to the high proportion of iron in the chromite which is in chemical combination with chromium. Theoretically, the ratio chromium = 1.28, but in this case the iron ratio chromium = 1.28.

Concentration Tests on Black Sand.

In an article entitled, "Separation of Metallurgies from Pacific Coast Sands," Henry E. Wood discusses the extraction of chromite and other minerals from the sands of the Pacific Coast. The following paragraphs are taken from this article:

"Possibly the largest amount of chromite in "sight" today is contained in the black sands of the Pacific Coast, which exist for many miles along the shores of California, Oregon, and Washington, where they are in view, in some regions, for many miles inland. For many years these attractive showings of fine, flake gold, and occasional scales of the harder platinum. The gold is in an exceedingly fine state of division, but satisfactory methods for its recovery have been adopted. As severe storms are of frequent occurrence, most of the equipment erected for such purposes has been wrecked, but it is plainly evident to the visor.

Disintegration of the serpentines formations, the presence of other minerals also. The individual particles appeared to be entirely free from impurities, so that no crushing was necessary. The chrome, garnet, and feldspar, friable minerals, were for the most part rounded; the quartz, tourmaline, and zircon angular. A screen analysis of the sand showed the following:

<table>
<thead>
<tr>
<th>Screen Analysis</th>
<th>Weight in</th>
<th>Cr2O3 in</th>
<th>Distribution in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesh</td>
<td>Weight in</td>
<td>Cr2O3</td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>Grams</td>
<td>Grams</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1000</td>
<td>100</td>
<td>100.00</td>
</tr>
<tr>
<td>Through 20—On 25</td>
<td>1000</td>
<td>100</td>
<td>100.00</td>
</tr>
<tr>
<td>Through 40—On 55</td>
<td>1000</td>
<td>100</td>
<td>100.00</td>
</tr>
<tr>
<td>Through 60—On 75</td>
<td>1000</td>
<td>100</td>
<td>100.00</td>
</tr>
<tr>
<td>Through 100</td>
<td>1000</td>
<td>100</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>100</td>
<td>100.00</td>
</tr>
</tbody>
</table>

In making the test the endeavor was to produce as clean a concentrate as possible with the idea that the value of a high-grade product would more than offset a slight loss in extraction occasioned.

One number of preliminary tests were made to determine the best conditions for carrying out the test. Briefly the procedure was:

1. Concentration on Wilfley table.
2. Wilfley concentrates dried and treated on Wetherill magnetic separator.
3. Product of Wetherill treated on Huff electrostatic separator.

Wilfley Table Concentration.—A sample of dry sand weighing 10 kilograms (22 lbs.) was fed automatically to a 24-inch Wilfley table, at a rate of about 13 kgm per hour (10 kgm in 45 min.). Two products were made—a quartz tailing and a concentrate containing chromite, garnet, and other heavy minerals. The feed was not charged as the proper determination of this point would have required more time than available.

<table>
<thead>
<tr>
<th>Results of Table Test.</th>
<th>Weight in</th>
<th>Cr2O3 in</th>
<th>Distribution in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Weight in</td>
<td>Cr2O3</td>
<td></td>
</tr>
<tr>
<td>Heads</td>
<td>Grams</td>
<td>Grams</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>1000</td>
<td>100</td>
<td>100.00</td>
</tr>
<tr>
<td>Tails</td>
<td>1000</td>
<td>100</td>
<td>100.00</td>
</tr>
<tr>
<td>Concentrate</td>
<td>8519</td>
<td>8519</td>
<td>9810</td>
</tr>
</tbody>
</table>

Concentration Ratio — 1.17 into 1 Extraction 97.36%.

Magnetic Concentration.—The concentrates from the Wilfley table were dried and then treated on a Wetherill two-double-magnet separator. The rate of feed was about 45 kgm (100 lb.) per hour. The feed belt had a width of six inches and was driven at the rate of 50 feet per minute. The magnets were set so that no adjustment other than that of changing the amperage was necessary throughout the test.
### Results of Magnetic Test

<table>
<thead>
<tr>
<th>Amperage</th>
<th>Product</th>
<th>Weight in Grams</th>
<th>% Cr₂O₃</th>
<th>Wt. Cr₂O₃ in Grams</th>
<th>Cr₂O₃ Distribution in %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heads</td>
<td>8290</td>
<td>30.06</td>
<td>2465.9</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>Tails</td>
<td>89</td>
<td>5.43</td>
<td>438.8</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>Garnet</td>
<td>360</td>
<td>10.63</td>
<td>374.2</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Garnet and Chromite Tails</td>
<td>3755</td>
<td>36.69</td>
<td>2948.78</td>
<td>83.4</td>
</tr>
</tbody>
</table>

Concentration Ratio — 1.42 into 1

Extraction — 99.25%

The amperage was then raised to 4 and the tails, consisting of chromite, garnet, and heavy silicates put through. This resulted in a product delivered from the magnets of mixed chromite and garnet, and a tailing of heavy silicates, such as zircon and tourmaline, which remained with the heavy minerals on the Willey table.

### Electrostatic Concentration

The mixed garnet and chromite product, resulting from magnetic concentration, was treated on a Huff electrostatic separator, using a single-roll roll-feed type machine, putting the material through ten times to approximate conditions of a 10-roll commercial machine. A tobergen feed type of six electrodes was available, but the single electrode was used as being easier of adjustment.

The voltage was maintained at 28,000. This resulted in two products—a high-grade concentrate and a tailing of garnet and chromite. This tailing might be returned to the Wetherill, using the Huff to produce a clean concentrate.

### Magnetic Product

Magnetic Product, 2.0 ampere

(Chromite and Garnet) — 35.66

Wetherill Tails (Heavy Silicates) — 0.97

Huff Tails — 15.16

Huff Concentrate — 45.82

The ferric oxide content of the concentrate was 28.26%. Assuming that all chromium in the concentrate is present as chromite, and that the formula of this chromite is FeO·Cr₂O₃·(FeO) by calculation there was an excess of iron equivalent to 4.49 ferric oxide over that necessary to combine with the chromium as chromite.

It will be noticed that extractions are based on weights and assays of products, or can be calculated from assays alone. However, as it is very likely that the garnet contains chromium, this will show an apparent recovery of the chromite lower than is actually the case. Clean garnet and chrome products should be obtained and the chromium content determined. This would aid in arriving at the true recovery.

The advantages and disadvantages of sizing and classification should be studied. It is probable that sizing will be found preferable—making two products—plus and minus 65 mesh.

### Concentration Test on Ferro-Chrome Slag

The material used in this experiment consisted of ferro-chrome in slag. This was irregular shaped pieces weighing half an ounce and less and shot the size of buck-shot and smaller. The angular pieces were for the most part rare from slag. The shot were imbedded in the slag.

Owing to the great difference in specific gravity between the ferro-chrome and slag almost any method of gravity concentration should be successful.

For this test a 4 x 6 inch two compartment Harz type jig was used. The material was first all crushed so as to pass a two mesh screen. A screen analysis of this product showed the following:

### SCREEN ANALYSIS

(All Through 2 Mesh)

<table>
<thead>
<tr>
<th>Wt. Gm.</th>
<th>% Wt. Cr₂O₃</th>
<th>Assay Wt. Cr₂O₃</th>
<th>% of Cum. of Total Cr₂O₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 + 4 mesh</td>
<td>1105</td>
<td>54.10</td>
<td>54.10</td>
</tr>
<tr>
<td>4 + 8 mesh</td>
<td>1400</td>
<td>22.44</td>
<td>76.64</td>
</tr>
<tr>
<td>8 + 14 mesh</td>
<td>220</td>
<td>10.76</td>
<td>87.39</td>
</tr>
<tr>
<td>14 + 20 mesh</td>
<td>76</td>
<td>3.66</td>
<td>96.95</td>
</tr>
<tr>
<td>20 + 28 mesh</td>
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<td>1.96</td>
<td>92.91</td>
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<tr>
<td>28 + 38 mesh</td>
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<tr>
<td>38 + 48 mesh</td>
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<td>1.71</td>
<td>95.68</td>
</tr>
<tr>
<td>48 mesh</td>
<td>70</td>
<td>1.71</td>
<td>93.86</td>
</tr>
</tbody>
</table>

Total | 2045 |

Wt. Heads — 2045 gm.

Assay heads — 12.16% Cr. Wt. Cr. in Heads — 248.7 gm.

The weight of the chromium in the combined weights of all jig products shown in the different sizes in the screen analysis (301.2)

<table>
<thead>
<tr>
<th>Weight Gm.</th>
<th>Wt. Cr₂O₃</th>
<th>Assay Wt. Cr₂O₃</th>
<th>% of Cum. of Total Cr₂O₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 + 4 mesh</td>
<td>1105</td>
<td>54.10</td>
<td>54.10</td>
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Total | 2045 |

Wt. Heads — 2045 gm.

Assay heads — 12.16% Cr. Wt. Cr. in Heads — 248.7 gm.

Weights of chromium in all jig products there are manifest errors in either sampling or assaying. Therefore, no extraction can be accurately determined. Moreover, as the slag itself contains chromium, this tends to show an apparent extraction actually lower than the real one.

Almost any method of gravity concentration would probably be successful. It may require grinding to finer than 2 mesh, but the larger pieces of ferro-chrome should be taken out first clean and then the tailings reground, as a saving in the cost of crushing would be effected thereby.

The discrepancies showing in the metal balances are due to the fact that accurate samples could not be secured, as it was desired to save a large part of each product for further examination.

As the weight of the chromium in the
Calcium Molybdate as an Addition Agent

In steel making, calcium molybdate* is used as an addition agent. This is done because molybdenum, like most similar metals, is commonly added to steel bath in the form of ferromolybdenum. It is essential to crush to about one-quarter of a ferro-alloy, usually less than a half pound of metal recovered, from the mining, through the usually concentrated heat, the manner of heating, and the final transportation.

To these must be added the cost of the electric smelting with its heavy losses, even in the best of practice, the difficulties of coming within the customarily rigid specifications of the consumer, and the uncertainty of selling the product when finished. It is easily seen, therefore, that if a fair and reasonable return is to be made to the producer, ferromolybdenum cannot become cheap enough to compete largely with some of the more common steel-alloying elements. Assume that every possible cost of mining and treatment has been brought to its lowest point. Then if any further decrease in cost is to be obtained, it becomes possible only through some improvement in the metallurgical treatment of the material, or through the elimination of some step in the preparation of a suitable product for the steel manufacturer.

With these facts in mind, it occurred that it might be possible successfully to introduce molybdenum into steel by the use of a salt of the metal rather than by the use of ferromolybdenum. Could this be done efficiently, the electric furnace reduction of ores and products would be eliminated and in its place a much lower-cost chemical treatment could be substituted.

Chemical Compounds as Addition Agents

The idea of introducing an alloying metal into steel by means of some salt or compound has been particularly new. It has been tried, both in the furnace and in the ladle, with certain of the metals, and with more or less success. Several difficulties, however, are encountered in considering the more common salts or compounds of molybdenum.

The ordinary 65 per cent molybdenite concentrate, or even the higher grade, is unfit for direct addition for several reasons. All such concentrates contain a certain proportion of silica and in general, in one or more oxides might be found in the case with which this compound is volatilized. At 1,200 deg. F. the vapor pressure of molybdenic oxide is quite high, so that recoveries from an addition at steel furnace temperatures would be unprofitably low. Such roasted concentrates would also carry the silica gangue of the unroasted material, and though it is possible to manufacture a more pure trioxide, the cost of such is prohibitive.

Since molybdenum unites in varying proportions with oxygen, it is possible that one or more might be found which would not be volatile at furnace temperatures. The difficulty, however, of efficiently producing such oxides makes such compounds of doubtful value for consideration as addition agents. Sodium molybdate might serve as another possible agent but for the higher cost of producing it of a sufficiently high grade.

In the case of some molybdenum ores, a step between concentration and the manufacture of ferro involves either a furnishing a chemical treatment for the removal of iron impurities, and as the result, the production of an alkaline salt of molybdenum, preferably calcium molybdate. Although in the production of ferro from molybdenite it is not always necessary to precede electric furnacing by a roast or wet treatment, such a process can be readily applied and a calcium molybdate of high grade very easily produced.

Theoretically, calcium molybdate should serve as an excellent addition agent to steel. It can be handled comparatively inexpensively made of a high-grade, containing practically nothing but the actio of molybdenum and calcium as the chief. The cost is easily reduced and the fine apparently prevents loss by volatilization of the molybdenum trioxide. Upon reaction of the molybdenum, by the carbon in the steel, the slag would simply serve as a small added source of material for the ordinary basic slag.

Early in 1918, in New York City, several small steel heats were made. An experimental electric furnace was employed and molybdenum was successfully introduced by the use of calcium molybdate with a recovery of 85 per cent.

In the production of alloy steel, molybdenum, like most similar metals, is commonly added to steel bath in the form of ferromolybdenum. It is essential to crush to about one-quarter of a ferro-alloy, usually less than a half pound of metal recovered, from the mining, through the usually concentrated heat, the manner of heating, and the final transportation.

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Encouraged by these tests and with the kind cooperation of P. E. McKinley, metallurgist at the U. S. Naval Gun factory, a commercial test was made at the Navy Yard in Washington, in September, 1918. The calcium molybdate was made from the wolframite of the Mammoth Development Co., of Los Angeles, furnished gratis by that company for the test. Using a Heroult furnace, ten tons of steel was made and at the proper time sufficient calcium molybdate added to introduce about 1 per cent molybdenum into the steel. The molybdenum content of the product, as shown by final analysis, confirmed commercially the previous experimental results. At a later date, C. E. Margerum, metallurgist of the U. S. Naval Ordnance plant at Charleston, S. C., employed the same method and secured an output of this steel at the Navy Yard in Washington. A third electric furnacing test was made at the plant of the Carbon Steel Co., in Pittsburgh, Pa. At this furnace was employed, and a repetition of the success of the two previous heats gave ample assurance that calcium molybdate was a satisfactory addition agent for use in the electric furnace.

Molybdenum in the Open Hearth.

Having succeeded in these attempts, it was intended that because of the strong reducing action of the electric furnace, the results obtained were to be expected. That the same success in the strongly oxidizing atmosphere and action of the open-hearth furnace was, however, open to argument, and considerable skepticism had to be overcome.

Experimentation has shown molybdenum to have less affinity for oxygen than either iron or carbon. Industrially, this is again proved by the fact that one in

the steel bath neither "swirling down" nor "tailing" appears to lower the molybdenum content.

Provided the molybdate could come in direct contact with the molten iron, it was thought that the metal could be reduced either by the metallic iron itself or by one of its reducing constituents. By the courteous aid of the officials of the Carbon Adelphi Co., 100 tons of iron and scrap were charged into one of the basic open hearths at their plant in Pittsburgh during November, 1918. At the proper time sufficient calcium molybdate was added to introduce the desired percentage of metal. Analysis of the ingots produced showed a high recovery of the molybdenum added, and the success so obtained amply rewarded the effort expended.

Early in May, 1919, with the kind interest and cooperation of the staff of the United Alloy Steel Corporation, a second open-hearth test was arranged. Two 100-ton heats and a third but smaller basic furnace heat was made and the desired amount of molybdate added in each case. The practically complete recoveries of molybdenum secured proved beyond question that molybdenum in this form may be successfully introduced into steel. In other words, in any type of furnace, it is only necessary to remember that the molybdate must come in direct contact with the molten iron, and therefore in the basic open-hearth it must be added just before the flame begins to heat up. A layer of slag would completely prevent contact with the metal. Slipped in sheet iron drums of convenient size, the molybdate is added, containers and all.

Advantages.

From the standpoint of the miner the production of calcium molybdate is particularly advantageous. In almost every occurrence, molybdenite is associated with considerable percentages of both iron and copper sulphides. In order to produce a marketable concentrate, all of the copper and a considerable portion of the iron must be removed. This may be accomplished by selective flotation, but this cleaning process not only adds to the operating costs, but invariably means a lower extraction. In other words, any copper or iron interfering in the production of calcium molybdate, so that the cleaning operations are entirely eliminated. If therefore becomes unnecessary for the miner to make a high-grade concentrate of the pyritic material, leaving the pyritic material behind as worthless, thereby reducing the amount of alloying metal required. Because of the economy that may be effected, the importance of this fact must be appreciated when considering molybdenum as an alloying metal to replace certain of the metals now being used, and for purposes in which it may serve equally well.

Method of Operation.

The introduction of molybdenum into steel by means of calcium molybdate involves no complications whatever, it being only necessary to bear the following in mind:

With the strongly reducing action and concentrated heat of the electric furnace, there was thought to be a possibility of reaction. Best results have been secured by introducing the molybdate immediately after skimming of the first, or phosphorus slag, the final slag from the bath being removed, of course, that reduction has been complete.

In open-hearth practice, the molybdate must be added in the early stages of the heat when the flux begins to show visible loss in the furnace bottom, but preferably a little before the melt becomes "level." In other words, in any type of furnace, it is only necessary to remember that the molybdate must come in direct contact with the molten iron, and therefore in the basic open-hearth it must be added just before the flame begins to heat up. A layer of slag would completely prevent contact with the metal. Slipped in sheet iron drums of convenient size, the molybdate is added, containers and all.

or to separate therefrom any of the copper or iron sulphides that might be contained. The millman will readily appreciate the saving that may thus be effected.

The production of calcium molybdate offers a further advantage in that the equipment for its manufacture does not involve great cost nor is especial skill required. The method employed is comparable to the cyanide process in that large tonnages may be readily treated and in many cases such may be established right at the mine. The electric-furnace production of ferro not only requires very large expenditures for tonnage treatment, but also necessitates particular experience and skill. Only in rare cases is the mining company in a position to carry out such an operation, and it thus becomes dependent on some metallurgical concern to put its product into marketable form.

Calcium molybdate is readily made, and with high recovery, from all molybdenum ores by simple chemical treatment. A ton of finely divided calcium molybdate carries approximately 49 per cent metallic molybdenum and contains no impurities detrimental to good steel manufacture. It is therefore obvious that molybdenum, in this form, is a very efficient addition agent for the introduction of the metal into steel.

The particular advantage of the process is that a carbon-free molybdenum addition agent may be afforded to the steel manufacturer at a price which will assuredly permit the competition of the unalloyed high-grade steel with the more general use. It is not within the scope of this article to point out the use or benefits of molybdenum in steel. The value of alloy steel in general is constantly becoming better appreciated. In the writer's opinion, molybdenum is the only metal commercially available in this country which is capable of developing in steels properties equivalent to those produced by metals which must now be imported. A possible strategic value exists in the ample and constant domestic molybdenum supply that is now assured. From the results of the work that is being done by concerns, as well as individuals of prominence, it is not only anticipated that molybdenum is an important place in the alloy steel industry.

RADIUM SCARCITY.

Owing to the scarcity of radium—which is now priced at $100,000 a gram—and the failure to discover new sources of supply, it is feared the shortage will become exceedingly acute. In the meantime, it is reported that radium for use in medical research is being prepared by a special method. A weak solution of radium, with the proper emanations; these, which are detected only by delicate instruments, are collected in tiny sealed glass vials and the vials are sent to medical men. It is stated that the efficacy of such bottled emanations lasts one week.
belligerent countries before and after the war is shown in the following table:

<table>
<thead>
<tr>
<th>Production of Coal in Certain Countries, 1913 and 1919.</th>
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</thead>
<tbody>
<tr>
<td>(In Millions of Metric Tons.)</td>
</tr>
<tr>
<td>United Kingdom</td>
</tr>
<tr>
<td>France (present boundaries)*</td>
</tr>
<tr>
<td>Belgium</td>
</tr>
<tr>
<td>Germany (present boundaries):</td>
</tr>
<tr>
<td>Bituminous</td>
</tr>
<tr>
<td>Lignite</td>
</tr>
</tbody>
</table>

It is pointed out by the Supreme Economic Council that from 1913 to 1919, the output of bituminous coal in the four European countries shown in the table has fallen from 635,000,000 to 356,000,000, the decrease being about 20 per cent in the United Kingdom and Belgium, and nearly 40 per cent in Germany. In the Saar Valley, whose output appears to have fallen from 12,000,000 tons in 1913 to about 8,000,000 in 1919, the percentage of decrease was over 30. The reduction in the French coal output is due to the destruction of the mines in the Nord and Pas de Calais.

The output of lignite in Germany in 1919, though less than in 1914, still greater than in 1913, was 94,000,000 tons, as compared with 87,000,000 in 1913.

In the break-up of Austria-Hungary the bulk of that country's production of lignite, the output of which amounted before the war to about 56,000,000 tons, was inherited by the Republic of Czechoslovakia. The output of lignite in Czechoslovakia was about one-third less than the same territory produced in 1913.

* Includes Alsace-Lorraine.
† Excludes Alsace-Lorraine and the Saar.

**COMMERCIAL GEOLOGY.**

The study of foreign mineral deposits and supplies by the Geological Survey, Department of the Interior, has been incalculable to the published annual inventory of our mineral production and resources of the United States. During the war, however, this study took on new importance, and work was begun on the study of the foreign countries' reserves of the essential minerals, resulting in the compilation, for the use of the Government, of a world atlas showing the production and resources of the more important mineral commodities.

After the data thus compiled had served the immediate confidential needs of the Government itself, the Secretary of the Interior warmly inquired the possibility of preparing the material for publication, so as to make it useful to the general public.

The "Atlas of Commercial Geology," the first part of which is now finished, will exhibit graphically the distribution of mineral production and of mineral resources. An effort is made to give the necessary data on the best known deposits and on the more important mines in all countries of the world, including the Great Lakes. It is expected that the map will give a clear idea of the geographical distribution of the raw materials which are the basis of the world's economy.

As the manufacture of steel increased during the war, the supply of iron ore became a problem of the highest importance. Through the advice of Mr. Van Allen, a literary correspondent of the Brooklyn Daily Eagle, the United States Steel Corporation has been enabled to secure large quantities of iron ore from the Ukraine, the Baltic provinces, and other sources in the European continent. The development of these sources of supply has been a matter of much importance to the steel industry of the United States.

For all Americans interested in amateur sport and recreation, 1920 is an important year, for the Seventh Olympic Games will be held in Antwerp this summer. Throughout the world the enthusiasm for the annual international competition of the American Olympic team has increased. The enthusiasm of the American public is evidenced by the large number of American participants who have been selected for the team. The organizers of the American Olympic Committee, points out that the spirit of the Olympic contest is peace and good will. The American participation in the Olympic Games is a demonstration of the spirit of international cooperation.

Consider for a minute the make-up of the American Olympic team, from all corners of the United States, from all professions and callings, have been selected. The success of the American teams in earlier Olympiads speaks pretty well for the geographical distribution of our favored nations. Yet the present industrial demands for fuels, metals, and other raw materials forces the American people to face the problems of industry in the near future. The "Atlas of Commercial Geology" will present the results of the survey of the mineral industry, and to ascertain these facts; the intensive study of our resources is not enough; we must also acquire a comprehension of what minerals other countries contain to supplement what we have at home.

If it were possible to construct a composite diagram showing the extent of the mineral production and the resources of the United States, it would be evident that the country is well supplied with all the essential minerals. The United States is the leading producer of coal in the world, and the United States Steel Corporation has been able to secure large quantities of iron ore from the Ukraine, the Baltic provinces, and other sources in the European continent. The development of these sources of supply has been a matter of much importance to the steel industry of the United States.

Though the war has had an adverse effect on the coal industry, the production of coal has increased in recent years. The output of coal in the United States has increased from 256,000,000 tons in 1913 to 356,000,000 tons in 1919, the percentage of increase being over 30. The reduction in the production of coal in Germany was over 30. The reduction in the production of coal in Germany was over 30. The reduction in the production of coal in Germany was over 30.

The increase in the production of coal in the United States has been due to the increased demand for coal in the manufacturing and mining industries, and to the increased demand for coal in the electric power industry. The increased demand for coal in the manufacturing and mining industries has been due to the increased demand for coal in the electric power industry. The increased demand for coal in the manufacturing and mining industries has been due to the increased demand for coal in the electric power industry. The increased demand for coal in the manufacturing and mining industries has been due to the increased demand for coal in the electric power industry. The increased demand for coal in the manufacturing and mining industries has been due to the increased demand for coal in the electric power industry.
— and these games go back almost into the prehistoric mists — that they were so important in classic days and are coming to mean so much in modern times.

The man who "goes out for" the American Olympic team, as well as the man who "goes out for" the American Olympic team, is an inspiration to the other young men of his community, particularly if he makes his way up to the final elimination test in Boston in July. It is interesting to have that even when a man has gone across to compete with the great athletes of other nations, it is the thought of applause from his own folks that steels will and nerve to the ordeal.

As when the Olympic games returned to his community crowned with wreaths of olive leaves, to become the village hero, so the American athlete returns to his own people to be idolized for the time being. After all, a nation is no stronger and no weaker than are the representative young men of individual communities. If the spirit of the town is opposed to the development of sports and recreation, there is no likelihood that a great athlete will ever be produced thereon that the people of the town will be noted for their progressiveness or their fair play. If Waterloo was won on the playing fields of Eton and Harrow, much more so will the Antwerp Olympic team be crowned on the gridiron or the playground.

So closely are the famed Olympic games bound up with true recreation and sport in the high schools and colleges. That the YMCA- Community Service, Inc., the successor of War Camp Community Service, which organized so many athletic programmes for soldiers and sailors during the war, is assisting the American Olympic Committee in various ways throughout the country. The Secretary of War has pointed out that the American Olympic Committee is important in physical education, apart from what it is doing in cultivating international good feeling. The YMCA-Community Service, Inc., and of the colleges and universities of America are identical with those of the Olympic Committee.

LARGE STEEL MANUFACTURER DECLARES METRIC STANDARDIZATION CAN BE ACHIEVED

Speaking for one of the large steel manufacturing companies of the United States, R. H. Page, Vice-President Truscon Steel Company, New York City, and Manager of the Foreign Trade Department of the Truscon Steel Co., of Youngstown, Ohio, has just declared to the World Trade Club of San Francisco, that in the steel industry, the advance to metric standardization could be made easily and without appreciable cost. Mr. Page declares that his company strongly favors the adoption of metric standards as it is the policy of the U. S. Army to deal exclusively in metric units and that the foreign trade of the United States would be greatly simplified by dealing in metric units and that the foreign trade of the United States would be greatly simplified by dealing in metric units and that the foreign trade of the United States would be greatly simplified by dealing in metric units and that the foreign trade of the United States would be greatly simplified by dealing in metric units.

He declares that the embargo does not real difficulties in the way of adoption of metric standards. "The heavy equipment in the industries in the steel industry — such as rolls in the steel industry — are of short life and could be entirely replaced with metric sizes in two or three years' time," he declares. "We could, of course, require somewhat longer to replace, but, meanwhile, the products thereof could be listed in their present metric equivalent, and our larger firms in certain lines already maintain duplicate equipment for the manufacture of metric sizes for their foreign markets, thus recognizing the importance of getting into step with the majority of the civilized nations."

Some of the other large steel manufacturers supporting the metric standardization and metric standards in their individual metrics are: For example: The Tacony Steel Co. of Philadelphia; The Victor Anmatograph Co. of Davenport, Iowa; Standard Steel Car Co. of Lockport, Pa.; American Wire Fabrics Co. of Chicago, Ill.; The Hydraulic Pressed Steel Co. of Cleveland, Ohio; The American Insulated Wire & Cable Co. of Chicago, Ill., etc.

X-RAY FINDS FLAWS

The difficulty of detecting flaws and the presence of foreign bodies, of a metallic nature, in built-up micas which is used for insulating purposes, has caused one large manufacturing company to install an X-Ray testing outfit for this purpose. With this apparatus foreign objects, such as pins, bits of wire, etc., as well as the weak or thin spots in the mica itself can be readily detected. The detection of these flaws has been made in various forms. X-rays of micas returned from service in a Harvard Endowment Fund were the first to show the need of a better X-ray testing outfit for the Harvard Endowment Fund.

Among other objects have since been achieved, for the country has been around the need of supporting higher education. There is a story, too, that is told in this connection. A well-known hospital in a major city had the Harvard Endowment Fund caused him to realize that he owed his own alma mater for the start she gave him in life.

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Funds Sought by American Colleges Total $250,000,000

That following the example set by Harvard, more than one quarter of a billion dollars is now being sought for additional endowment by hundreds of institutions of higher learning in this country is pointed out by Mr. F. W. Page, manager of the Harvard Endowment Fund, in an article which he has written for the March issue of the Harvard Graduates' Magazine. The Endowment Fund is estimated to be rapidly fast approaching the $12,000,000 figure.

Mr. Wadsworth has gone to Europe to attend the first congress of the League of Sports. The larger companies in central cities have already maintained duplicate equipment for the foreign market, thus recognizing the importance of getting into step with the majority of the civilized nations.

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Mr. Wadsworth says:

"The fact that individuals have any definite responsibility to the maintenance of our educational system, was not recognized," says Mr. Wadsworth. "Citizens voted once a year for members of the school board. College Alumni voted at that convention as directors of the university and members of the governing board. This, to a large extent, was the measure of our interest and thought."

Looking back over the last six months since the Harvard Fund was started, Mr. Wadsworth says:

"It may be safely said that Harvard has played a very important part in leading this movement. The first plans for the campaign it was determined that the publicity for the Harvard Endowment Fund should have two objects: First, to show the need of a better Harvard; second, and far more important, to show the serious situation which confronted all educational work."

Many objects have since been achieved, for the country has been aroused to the need of supporting higher education. There is a story, too, that is told in this connection. A well-known hospital in a major city had the Harvard Endowment Fund caused him to realize that he owed his own alma mater for the start she gave him in life.

"Together with the growing sense of the danger threatening our institutions, there has come consistently growing cry for more education. The steel strike, the coal strike, the evident need for better Americanization have developed writers and orators galore all raising their voices in the same cause. More and better education for the masses; a higher and broader intellectual development of the country. It has been advocated in many unimportant terms. No political speech is complete without its mention of our needs for better Americanization — which means education. "No discussion of the industrial problems which confront the country fails to bring forth the need of a better understanding between employer and employee; the serious situation which confronted all educational work."

"And so, side by side have arisen these two great changes in public sentiment; growing recognition of the individual for the support of the education and the upholding of the standard of education; second, the realization of the enormous importance of higher education in the future development of America."

Mr. Wadsworth lays stress upon the practical support given by the late Henry C. Frick, who "wrote in his will a testimonial as to his opinion of the value and importance of our institutions and the seriousness of our institutions of higher learning."

Mr. Rockefeller, he says, "has expressed himself in these terms, his feeling as to the importance of aiding higher education to this country by his gift of $50,000,000 for the distribution among colleges of the country."
GENERAL.


This article deals with the problems confronting the War Department in the disposition of its nitrogen plants. The Fixed Nitrogen Research Laboratory was therefore established in Washington to investigate the uses of nitrogen as a fertilizer. This work includes the hydrating of lime nitrate, the granulation of urea and ammonium nitrate, and the production of various forms of ammonium. The operation of the plant using the Haber process depends on the finding of an active catalyst for the reaction between hydrogen and nitrogen. The problem of fixation by the electric arc is being studied because it may be installed rapidly in times of emergency. German research work on these problems is said to have employed 250 chemists during the war. J. A. H.

Stabilization of Coal Industry Depends on Improving the Wood Situation. By Howard N. Eavenson. (M. & M., June, 1920.)

Thirty per cent of the by-product ovens of the United States Coal and Coke Company have been shut down because of the coal shortage. This shortage has been so acute that private cars of the company have been diverted to other parts of the country and have not been returned. This shortage has caused a ten per cent reduction in the total loss of time in the past six years. The lastest recommendation for solving the difficulty in coal consumption is by the electrification of industries. J. A. H.

The Fertilizer Situation. By Milton Whitney. (C. & M. E., June 12, 1920.)

The merger of the smaller companies which produced the old brands of fertilizers in large corporations has made it possible to elevate the trade into a real chemical industry. A characteristic of phosphate rock with sulphuric acid entails a loss of two-thirds of the rock because it contains iron, alumina, and phosphoric acid. This compound is difficult to transport as an acid but it can readily be changed to a soluble salt. Cottonseed meal, animal tankage, and the other waste products which once supplied nitrogen to the fertilizer industry have become so prominent as animal feeds that their price makes them prohibitive for the former purpose. These materials are so necessary to give the fertilizers a proper mechanical texture that some substance must be found. The logical source of supply is from fixed nitrogen products, such as calcium, cyanamide, ammonia, or some of the compounds of nitrogen. These products could be mixed in so concentrated a form that they would require 80 per cent of inert fertilizers. The dissolving agents would be very economical as water, soil, or sand could be used. Ordinary phosphatic phosphate is prepared by fusion of a mixture of potash, shale, phosphate rock, and coke, and precipitation the volatile matter. This process is too expensive because it raises the strength of steel and the point of fusion. J. A. H.

A Comparative Test Upon High-Speed Steels—II. By A. J. Langhammer, M.E. (C. & M. E., May 12, 1920.)


The refinery on the Kyphtim estate, in the Ural Mountains, was seized by the Bolsheviks in 1917. The whole operation of the plant was so poor that at least one quarter of the copper, gold, and silver was needlessly wasted. A commission was appointed to investigate accidents, most of which regarded the treatment of smelting, and that of steel were crushed, classified, concentrated and prepared for shipment under the new federal law. This capacity has been decreased, but the efficiency of concentration has been greatly increased. The author believes that gravity concentration may be made a constant by selecting only those plants which have the chemical composition of the steel, and the chemical composition of the steel. J. A. H.

METALLURGY AND ORE DRESSING.


The manufacture of high-speed steel has grown in sixteen years from a metallurgical experiment to an important industry. The selling methods are disappointing as salesmen will often make tests with a special quality and fill orders with poor-quality grades of steel. The cutters are also at fault in using cheap steel, or steel of various brands, which may require different treatment, thus throwing the whole plant into confusion. Carbide steels are now falling into disuse because of the premature dulling of the cutting edges. It was succeeded by molybdenum steel, which had increased speed 60 per cent, but which is yet too slow for present use. Its speed was increased 400 percent by high-speed steel which will retain its cutting edge to the point of breaking down. Steelite, an alloy of iron, chromium, and molybdenum, has 100 per cent of the high-speed steel for cutting cast iron, and 700 per cent faster for cutting bronze, but its efficiency is reduced by its inability to withstand high speeds. Cast iron is a promising innovation, but its value is not yet fully proved. English brands of steel, made without tungsten, are also used. The chemical composition will generally betray a poor steel, but it is one of so many factors that it is not a guarantee of a good steel. The efficiency of a steel is high when it is made by a process which raises the strength of steel and the point of fusion. J. A. H.


It is said that the reverberatory furnace has doubled the efficiency of the blast furnace. Much of this efficiency has been due to a cut in expenses by using slack coal instead of oil. The furnaces are being made slightly wider with straight-line arches and larger uptakes and flues. Side-charging is the standard practice in Arizona, and the continuous slag-tap is coming into general use.

A Comparative Test Upon High Speed Steels—III. By A. J. Langhammer, M.E. (C. & M. E., May 19, 1920.)

The fundamental factors of a test are the steel, the manufacture of the tool, its heat-treatment, its grinding, the working dies, and the chemical and mechanical properties of these. A high-speed steel was ordered, without mention of the tools. When the tools were made they were hardened according to the specifications and then tested. High-speed steel is used in cutting the whole plant into concision. Carborundum was needlessly wasted. A commission was appointed to investigate accidents, most of which regarded the treatment of smelting. J. A. H.
Steam boilers are the most efficient agents for the recovery of waste heat, as connecting fires must be as short and of large cross-section, to prevent loss by radiation. J. A. H.

The Metallurgical Research Department of the Utah State School of Mines. By L. W. Chapman. (C. & M. E., May 12, 1920.)

The offices of the Department of Metallurgical Research, and of the U. S. Bureau of Mines have been installed in a large fire-proof building erected by state appropriations and public subscription. The offices are equipped with grinders, crushers, diverse equipment, and large and small grinding machines. The testing laboratory is equipped with testing machines, flotation machines, separators, and hydraulic presses. The general procedure is to determine whether a binder is necessary, what pressure gives the best results and whether the material will permit the use of the blast for the flotation of various ores. The grinding equipment includes guides, jigs, and heavy and light tables. The milling equipment includes Hartz jigs, Deister-Overstrom and Overstrom-Universal Tables. The grinding machines are operated by an operator who knows his work. Clarity of filtration is due to the supererative straining of particles of suspension from the liquid. When fabrics are used the clarification begins after a layer of sediment has been deposited on the filter cloth; a layer of two or three layers of thin cloth is objected because it has the disadvantages of both thick and thin fabrics. This plan is practical only when the thin fabric is made of burlap or matting. In obtaining clarity one of the most important necessaries is to have proper agitating devices. Filter aids will help if they have a low specific gravity, high filtering characteristics and an inert chemical composition. J. A. H.

Scientific Control of the Filter Station. By Arthur Wright, M.E. (C. & M. E., June, 1920.)

Modern industrial filters will quickly drop below their capacity unless they are handled by an operator who knows his work. Clarity of filtration is due to the supererative straining of particles of suspension from the liquid. When fabrics are used the clarification begins after a layer of sediment has been deposited on the fabric. The layer of two or three layers of thin cloth is objected because it has the disadvantages of both thick and thin fabrics. This plan is practical only when the thin fabric is made of burlap or matting. In obtaining clarity one of the most important necessaries is to have proper agitating devices. Filter aids will help if they have a low specific gravity, high filtering characteristics and an inert chemical composition. J. A. H.


The needs of the automobile industry led to the first scientific investigations of what different types of steel would do under different conditions of shock and strain. The study included fractures of the car produced by accidents. Fracture tested by different means was fracture of the material, even though the shock is evidently greater at the surface. J. A. H.


Until the last few years the petroleum industry of the West had been unable to obtain Eastern capital because of the apparent lack of a market for its product. Five important factors have disintegrated this obstacle, which can no longer exist. The region is admirably located to supply the demands of the vast territory where oil is neither found, and of the ever-increasing population. New oil fields in the North, as well as in Colorado, New Mexico, Arizona, and Utah would find an immediate market for their product. The Midwest Refining Co. used this market for a refinery site in 1917, and daily capacity increased to 60,000 barrels of crude oil. The market is so large that essential in forging. Electric furnaces are of great advantage in the mixing of the alloy. The results of the tests demonstrated that tools of the same bar and treatment subjected to the same working conditions, gave widely varying results. The tests were checked by other single tests and the average results were practically unchanged. Nine other companies using tool steel supplied information which verified those of the packard tests described. Superior tool steel has the effect of saving of five to ten per cent in labor costs as they can be depended upon in critical times. The results of the research of the best steels reveals a large percentage of tungsten and chromium as compared with the other materials. Microphotographs of annealed steel showed wide variations in structure. The hardened steel practiced all the carbides were taken into solution. J. A. H.
PERSONALS

W. E. Hindry is located at Pasadena, Calif.

John V. Richards is with the Bishop Creek Mining & Milling Co., Bishop, Calif.

Montague Butler, Dean College of Mines and Engineering, Tucson, Arizona, was a Golden visitor recently.

P. Jay Lonergan’s address is Lewiston, Wash.

Rush Tabor Sill is located at 1011 South Figueroa Street, Los Angeles, Calif.

M. W. French is chief chemist, Granby, Conn., M. S. & P. Co., Anyox, B. C.

John V. Richards is with the Bishop Creek Mining & Milling Co., Bishop, Calif.

Rush Tabor Sill is located at 1011 South Figueroa Street, Los Angeles, Calif.

S. P. Warren, who has been working at the Ore Testing Plant in Golden for several months, is now at Climax, Colo.


James W. Dudgeon, formerly with the Basin Salvage Co., Basin, Mont., is now with the Davis-Jolly Copper Co., Butte, Mont.

Mr. and Mrs. John R. Davis, of Banock, Muat, are rejoicing over the arrival of an eight-pound daughter.

Fredrick F. Fosie is at present in London on business.

Neil M. McConnell, of Bisbee, Arizona, is spending several weeks in Golden.

Adolph Bregman is located at 155 W. 84th Street, New York City, N. Y.

Van Gleave A. Donovan has resigned from the Sinclair Consolidated Oil and Gas Co., Wichita Falls, Texas, and is temporarily at Park City, Utah.

John J. Cadot is production manager of the Hardinge Company, and is temporarily located at Park City, Utah.

Howard L. Minster is located at 303 South 5th Street, Laramie, Wyo.

Van Dyne Howbert was married to Miss Helen Louise Weiffenhach on June 10th, Denver, Colo. They will reside at Saltiito, Co., Montana.

Max T. Hoffs has returned to Belize, British Honduras, C. A.

George M. Cheney, formerly of Guayaquil, Ecuador, is now with the Anaide Copper Co., Antofagasta, Chile, S. A.

Rene J. Mechin was married to Miss Carolyn Elizabeth Smith on June 23rd at Manila, Teem. Mr. Mechin is in the engineering department, Cia de Santa Gertrudes, Pachuca, Hidalgo, Mexico.

Juan E. Serrano is with the Ingenio Rand Co., Easton, Pa.

Quirico A. Abadilla’s address is care Geocologico Department, Cia Mexicana de Petroleo, “El Aguila,” Tampico, Mexico.

Vicente J. Lynch is with the Phelps-Dodge Copper Co., Tyrone, N. Mex.

Herbert K. Linn’s address is care Geosque de Petroleo, “El Aguila,” Tampico, Mexico.

George G. Goodwin has gone into business with his brother at Fresno, Calif. His address is care Pacific Tent & Awning Co.

Luther J. Buck was married to Miss Marjorie Broad of Golden, Colo., at Butte, Mont., June 16th. They will reside at Anaconda, where Mr. Buck is employed in the mill testing department of the Anaconda Copper Co.

EX-MINES NOTES.

Walter H. Wiley’s address is Palm Drive, Glendora, Calif.

Harold S. Munro has resigned as manager of the Consolidated Copper Co., Kimberley, Nev., to become general manager of the Granby Con. M. S. & R. Co., Anyox, B. C.

John A. Baker is in charge of the ore testing plant of the Dorr Co. at Westport, Conn.

WHERE ARE THESE MEN?

Wm. B. Middleton, ’83.

Miffin M. Butler, ’19.

Sidney W. French, ’08.

Horace T. Reno, ’02.

Chas. E. Wheeler, ’34.

Wm. B. Patrick, ’09.


R. A. Thorstein, ’17.

W. A. Comics, ’13.

Howard I. Flint, ’19.

Walter A. Funk, ’83.

SCHOOL NOTES.

Dr. Victor C. Alderson sails for this country from Liverpool July 21st, on the Olympia.

THE RED CROSS ROLL CALL.

The Fourth Red Cross Roll Call will be held from Armistice Day, November 11, to Thanksgiving Day, November 25, next. For the first time in the history of the end of hostilities in the World War will be the occasion for the American public to renew its Red Cross allegiance through dollar memberships.

This was made known recently by Dr. Livingston Farrand, chairman of the Central Committee, when he announced that as a result of the last Roll Call the Red Cross now has more than ten million members. This is more than twenty times the pre-war membership of the society and does not take into account the fourteen million school children who are members of the Junior Red Cross.

The membership dollars will be used to further the gigantic peace time activities of the American Red Cross, which are:

To continue work for America’s veterans of the World War, particularly the disabled.

At the Red Cross Institute for the Blind near Baltimore, more than half of the American soldiers blinded in the World War have already been trained for living and earning without their sight.

To serve our peace-time Army and Navy.

The Government has requested that the Red Cross continue its responsibility, particularly that of acting “as a connecting link between the enlisted men and their families.”

To develop stouter national resistance to diseases through health centers.

The Red Cross chapter in Seattle, Wash., alone is establishing twenty-five Red Cross health centers in the towns of King and Kitsap Counties.

To increase the country’s nursing resources and to cooperate with official health agencies.

When influenza visited New York City, the Red Cross supplied 12,800 blankets, towels, nightgowns, in­

Jum E. Serrano is with the In­

eight articles within a few hours. In Chicago, 14,000 women trained by the Red Cross during the war were called to sickroom service.

To continue preparedness for disaster relief.

Mobile relief units, consisting of food and medical supplies, are stored in Red Cross warehouses all over the country. In time of disaster they can be rushed to the stricken community.

To continue Home Service and community work.

Red Cross Home Service workers are in forty-five U. S. Public Health Service hospitals, with a possible population of 10,000 patients.

To complete relief work among the war-torn and disease-ridden people of Europe.

Ten millions of the 40,000,000 souls in the Balkan States alone were beneficiaries of Red Cross bounty in seventeen months of relief work there. The food and clothing and medical relief supplied are given as “gifts of the American people.”

ELECTRIC TRACTION POPULAR IN BELGIUM.

Why Belgians want electric traction is brought out in a recent issue of Electrical World. The Belgian government has decided to start electrifying its railroad beginning with the line from Brussels to Antwerp. Economically, steam lines are cheaper, they operate electric, and the installation costs are lower; but these are counterbalanced by the possibility of running increased freight and passenger service by electric methods.
PROFESSIONAL CARDS

BROOKS, EUGENE C.
Mining Engineer.
229 Coronado Bldg.,
Denver, Colo.

MILLIKEN, WILLIAM B.
Mining Engineer and Metallurgist.
709-10 Mining Exchange Bldg.,
Denver, Colo.

BURLINGAME, WALTER E.
Chemist and Assayer.
1756-38 Lawrence Street,
Denver, Colo.

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Los Angeles, California.

TAYLOR, FRANK B.
Geologist and Oil Expert.
Reports and Investigations.
Box 326, Casper, Wyo.

WALTZ, W. D.
1315 First National Bank Bldg.,
Denver, Colo.
Phone Champa 5236.

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42 Broadway,
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