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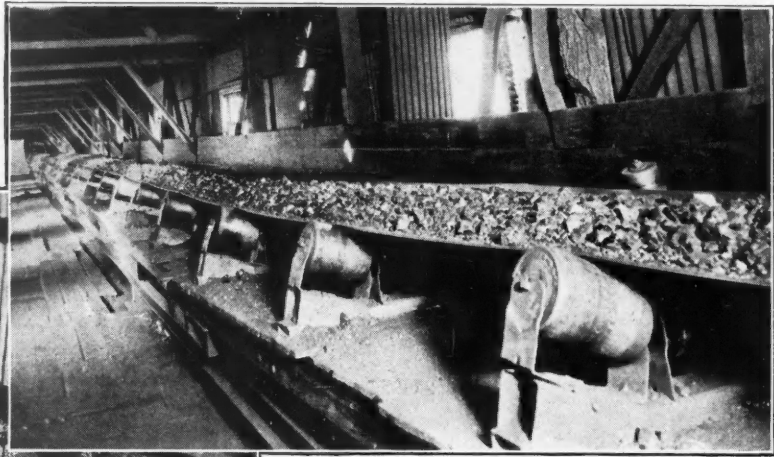
Placing in
Tropic Countries
Biography of
George H. Garrey

Hoisting men in one of Calumet & Hecla's mines

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

September 16, 1922

S-A Unit Carriers in re-screening plant of Orient No. 1 Mine of C. W. & F. Coal Co., Orient, Ill.



S-A Unit Carriers in tipple of Zeigler No. 1 Mine of Bell & Zoller Mining Co., Zeigler, Ill.

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ENGINEERING & MINING JOURNAL-PRESS

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Volume 114

New York, September 16, 1922

Number 12

The Alaska School of Mines

A MOST NOTABLE EVENT, and one which is indicative of the progress of Alaska, is the establishment of an institution of advanced technical learning at Fairbanks. The current month sees the opening at that place of the Alaska Agricultural College and School of Mines, the farthest place north of all English-speaking colleges. Instruction which shall help in the development of farming and mining in our great northwestern territory will henceforth be available at home, for the residents of that promising region.

Few people realize the vastness of the dimensions of Alaska and how much the territory varies in its different portions. Although the area is about one-fourth that of the United States, even this does not give an adequate idea of the immense distances, the great natural obstacles to easy travel and communication, and the variety of topography, vegetation, geology, and climate. The fact that Sitka, the former capital of the territory, has a mean annual temperature about the same as that of Washington, D. C., and that its present capital, Juneau, is in the same general climate, is confusing to some who fail to appreciate the significance of these conditions. Like a great rampart, the Coast Ranges of Alaska divide the mountainous coastal belt from the interior. The former is warmed and copiously watered through the influence of the Japan Current. On the north and east of these ranges lies the Alaskan table land, sloping to the Arctic and to the Bering Sea. The Yukon rises within thirty miles of the coast—near Juneau—and flows north and west thousands of miles before entering the Bering Sea, just south of the Arctic Ocean. It carries more water than the Mississippi. This main portion of Alaska has a severe winter climate, a short, warm, sub-Arctic summer, and nevertheless has climatic conditions under which hardy populations thrive in Europe, and considerable possibilities for agricultural development, for crops grow with double speed and vigor in the long, warm summer days as compared with more southerly climates.

In Alaska, in the spring, the traveler may find unmelted snows on the north side of a ridge, and grass and flowers knee-deep on the south slope. In the early days of Alaskan placer mining, it was not uncommon to plant a vegetable garden on the roof of a log cabin. The warmth of the cabin below and the long warm sunlight above accomplished a swift maturity which was quite surprising. There are vast stretches of alluvial lands along the rivers which doubtless some day will yield large crops of the more hardy grains. On the barren tundras herds of reindeer have been successfully raised in recent years, and this industry has revolutionized the welfare of the Eskimos of the coastal belt, who from having to depend, as in former times, on an eternal diet of fish, have now become in many cases the owners of reindeer herds.

Fairbanks is on the Tanana River, an important

stream which empties into the Yukon. It is apparently destined to be the central station for transmontane Alaska. It is central for the mining industries also. It is situated in an important placer district, and the placer districts of the Yukon are of easy access from it, and the other placer districts of the region are also relatively accessible. There are gold-quartz veins near Fairbanks, a form of ore occurrence not very common in transmontane Alaska, although placers are common.

The natural routes of communication from Fairbanks lie not only down the Yukon to its mouth, but up the Yukon, over the White Pass to Skagway, which is near Juneau; and through the new Government railway it will be the gate of easiest communication to the sea, which at the ocean terminal of the railway is open summer and winter.

The Tariff and the Executive Branch

AN IMPORTANT ADVANCE in our methods of tariff determination is contained in the flexible feature of the new tariff bill, whereby the President is empowered to change tariff rates fixed by Congress, up to a maximum of 50 per cent of the rate established by Congress, either up or down. The initiative for any such change will come from the Tariff Commission, which is authorized to hold hearings and conduct continuous investigations in order to find the glaring shortcomings in the operation of the tariff rates as fixed by the legislative branch; and when the Tariff Commission is ready with any recommendation, it will submit it to the President, who will take such action as he sees fit.

This voluntary action of Congress, in extending to the Executive branch of the Government a share in its prerogative of fixing tariff rates, marks a milestone in our progress. It recognizes the scientific basis of tariff fixing, and is a precedent which will undoubtedly lead to more carefully balanced and more economically sound tariff policies in the future than in the past. The country has been suffering from a protection policy which has swung between extremes.

It is altogether likely that the Tariff Commission will be kept busy under the new plan, by those who desire certain rates lower or higher, and are ready with facts, figures, and arguments to support their pleas. It would indeed be most unfortunate if it were not so, and if the Tariff Commission and the President did not avail themselves of these new powers and make their uses familiar to the country. Of course the commission and the President will naturally act along the understood lines of Republican party policy; and to make this certain, Congress has limited the period of exercise of these powers to July 1, 1924, so that in the event of the incoming of a Democratic President, he would not be able to scale down the tariff rates forthwith, in accordance with what is generally understood to be the broad theory of the Democratic party.

An Enemy of the Mining Industry

HARDLY AN ISSUE of the *Journal-Press* appears but what some mention is made in its pages of a disastrous mine fire or the destruction of surface plants and buildings by fire. In recent weeks the entombing of forty-eight miners in the Argonaut mine, and the almost total demolition of the large and modern concentrator at Ely belonging to the Nevada Consolidated Copper Co., are vivid reminders of the toll exacted by this enemy—and friend—of mankind. Nor is the devastation by fire confined to the large properties. Only two weeks ago we recorded the result of a serious conflagration in the surface plant of the Cornucopia Mines Co., a small gold mine in Oregon. Other examples might be cited, but practically every mining district in the United States can recall a fire that has proved disastrous to operations. Frequently only a few minutes are required to obliterate a plant that may represent a heavy investment for a mining company. In fact, one of the amazing things about mine fires is the generally rapid rate at which mine timbers or mine plants are consumed. It seems that unless a mine or plant fire is checked exceptionally quickly the chance of extinguishing it later is slim.

Of course the very nature of mining generally prescribes the use of temporary supports in mines and temporary surface structures. Wood is the most popular structural material in mining, and its use naturally increases the fire hazard. If the loss of buildings were the only exaction of devastation by fire, adequate provision could be made by covering the buildings with insurance heavy enough to permit the prompt restoration of the plant. However, the attendant loss of life and of employment, and the waste in having capital idle, are contingencies not so easily guarded against.

It is interesting to observe in the recent fire of the Nevada Consolidated concentrator that although the building was made of steel, with concrete foundations, it contained wooden ore bins and a wooden roof sheathing structure which apparently furnished the fuel for the flames, aided considerably by wooden concentrating machinery. The company carried, according to the official statement, only sufficient insurance to cover the maximum loss by fires that seem possible of occurrence considering the "fireproof" character of the mill. It has already contracted for a new structure to be constructed of steel throughout, which will contain no wood except in machinery where wood is necessary.

It usually takes bitter experience to drive home the necessity of taking extraordinary precautions against the outbreak of fire, and those companies that have "been through the mill" are generally found to have made every effort to avoid the recurrence of trouble. The North Butte Copper Mining Co., in concreting its Granite Mountain shaft and tributary stations, has profited by the disastrous fire which occurred there several years ago with a heavy toll in life. The shaft is now a beautiful—if it may be so termed—example of modern shaft construction, and so clean that one may easily descend the entire 3,600 feet of shaft without being deluged by water and mud as in many unlined ones. Concreting this shaft has been a costly affair, but not so costly as another mine fire and the loss it entails.

The new South mill of the Homestake Mining Co. in Lead is a modern affair which is constructed of steel and concrete with the exception of floors, launders, and a few other items. The Homestake has also had bitter experience with fire, but especially in its under-

ground operations. In the Cœur d'Alenes the mill and other surface plants are largely constructed of wood, but the Hercules concentrator is a notable exception. A year or so ago Bunker Hill & Sullivan had a destructive mill fire that severely taxed the fire-fighting efforts of its employees. The new mill, recently constructed, although built of wood, has its wooden members "gunited" to give a fireproof covering. The Bunker Hill has taken unusual pains to prevent another fire and has given much thought and attention to the most effective fire-fighting apparatus. High-pressure hose and nozzles are distributed judiciously around the plant where they are quickly available. Extinguishers are prominent in its buildings, and it is quite evident that everything possible has been done to insure the complete protection of the extensive plant of the company.

Perhaps we are deluded in believing that the havoc wrought by fire lately has been larger than for some time past, but, in any event, we think it an excellent time for every mine executive or employee who has perused these remarks to take stock carefully of his fire-fighting apparatus, of the precautions taken to avoid fire, the drilling of employees, cleaning out of inflammable rubbish, fire insurance, and the like.

Operations at Katanga

AT THE recent annual meeting of the Union Minière du Haut-Katanga, the company identified with Tanganyika Concessions, Ltd., in central Africa, it was stated that the reserves of copper ore developed at the Katanga mines amounted to 64,900,000 tons, containing 4,315,000 tons of copper. The meeting was held at Brussels, for the Union Minière is a Belgian enterprise founded on British initiative. The president is Mr. Jean Jadot, and the vice-president is Mr. Robert Williams, the pioneer of this mining adventure and a man of indomitable persistence, to whom, indeed, the enterprise owes both its birth (in 1899) and its present vigorous life. The reserves are stated to consist of 3,600,000 tons of 17 per cent smelting ore, 11,000,000 tons of 7.4 per cent concentrating ore, and 38,000,000 tons of 6.3 per cent leaching ore. In June the production of copper was 3,982 tons, which is the largest monthly output to date. The expectation is to produce 40,000 tons of copper during the current year. Last year, owing to the shutdown at our American mines, the Union Minière was the largest producer of copper in the world, its output having been 30,460 tons. It is proposed to employ a leaching-electrolytic process, after the style of Ajo, but this cannot be done without raising fresh capital, as the necessary plant and construction will involve the spending of a large sum of money. Last December the company was authorized by its stockholders to issue 300,000 preference shares of a nominal value of 500 francs each. A plant for agglomerating fine ore has been erected at Lubumbashi, where the smelter is situated. The accounts for the past fiscal year, that ending on Dec. 31, 1921, show a gross income of 9,570,241 francs, which sufficed to pay interest on debentures and other obligations, but left no money for dividends to the stockholders. The comparatively unprofitable character of this enterprise is due to the one fact that the item of transport alone amounts to one-half of the total cost of production, owing to the enormous distance that the copper has to be carried before it reaches a seaport, at Lobitos Bay, on the west coast.

The Michigan Copper Industry

RESUMPTION OF DIVIDENDS by four important Michigan copper producers last month again attracts attention to the oldest copper-producing section of the country. Calumet & Hecla, Isle Royale, Osceola Consolidated, and Ahmeek together paid close to half a million dollars; and in addition to these, Copper Range, Champion, St. Mary's Mineral Land, and Mohawk resumed the payment of dividends in the preceding months of the year. These profits are not all coming from current operations exclusively, however, for it must be remembered that copper stocks have been dwindling fast, and that much of the income from the sale of metal in recent months has not been charged with the normal expenses for production. Nevertheless, it is evident that the various boards in charge of these companies feel that sufficient profit can be made from normal operation in the future to warrant the resumption of dividend payments. This is distinctly encouraging, for those in authority in "the copper country" have been none too optimistic and feared that the gradual lowering of the grade of ore, coupled with the increasing costs of deep mining and the competition of the automobile industry for labor, would make the continuance of operations on the old scale difficult.

The grade of ore is low—running from about 0.6 to slightly over 1 per cent normally for most of the mines, though in the last year higher-grade ore averaging from 1 to 2 per cent has been selected. Some companies, as the Champion, have normally milled ore running close to 2 per cent. Translated into local terms, the "rock" treated, and on which profits are made, usually runs from around 13 lb. per ton, as was the case with the Osceola in 1918, to 20 or 21 lb., which was the grade treated by Calumet & Hecla and Ahmeek in the same year. In 1921 the "rock" treated by Calumet & Hecla reached the high figure of 37.7 lb. per ton, but this was specially selected material. All of the copper occurs in the native state, and thus the ore requires methods of treatment peculiar to the district. In crushing, the ponderous and powerful steam stamps are the feature, and, we believe, are used nowhere else. Each head has a capacity of from 350 to 700 tons per day. The presence of large masses of native copper offers apparently insurmountable difficulties in the use of any other machine, such as the disk crusher for instance. The product of the stamps is treated in small jigs and on tables. Latterly, regrinding in ball mills, and flotation, have been introduced, and at the Calumet & Hecla ammonia leaching of the tailings from the regrinding plant, including material from tailing ponds. The copper is precipitated by distilling off the ammonia.

Smelting is, of course, purely a melting operation. Small reverberatory furnaces are used—only about one-quarter the size of those employed in the large matte smelters of the Southwest. Many of these are fired by hand on grates, in the old-fashioned way, though powdered-coal firing is being introduced in the district and will no doubt be the universal practice in time. Some of the coarse material, such as the large pieces of mass copper, is melted in cupolas. Other small reverberatories are provided for the refining operation, which comprises blowing with air, and poling, as is the common practice. Some of the ore contains sufficient silver to make electrolytic refining advisable, and the Calumet & Hecla has therefore erected an electrolytic refinery, of a capacity of 65,000,000 lb. of copper per year. The

silver also occurs native, and small particles can often be seen, along with the native copper, in the concentrate, or "mineral," as it is called in native parlance.

The visitor accustomed to the recovery of copper from sulphide ores is impressed by the unusual features of the flow sheet as above outlined, and also by the great depth of the mines, and by the fact that no hydro-electric power is available. The Tamarack No. 3 shaft has attained an inclined depth of over 15,000 ft., approximately one mile vertically. The new hoist at the Quincy, standing 60 ft. high, fairly staggers one by its size. It is the largest in the world. All of the machinery throughout the mines and surface plants is driven by power generated from the burning of coal. This is unfortunate, particularly at present, when fuel is so expensive and difficult to get at any price.

In the last few months labor has been the chief cause of worry for the officials, as one of our editors who recently visited the district learned. With copper at 14c., and with other costs of production still much above normal, it has been impossible to pay the employees a fair rate of wages. The alternative has been to close down altogether. The reduction of the wage scale has been the only means available to keep the cost of production below the selling price of the metal produced. As a result, the less skilled men are getting as little as \$2 a day. This, in itself, is sufficiently discouraging, without the knowledge that men working on the railroad right alongside of them are getting around \$5 per day. This is one of the best evidences that we have seen of the unequal conditions that still persist, though in general in a lessened degree, as the result of the turmoil of the last eight years. The inevitable result has been that the men are leaving by every train to go to places where the reward is greater, chiefly to Detroit apparently. As one official pointed out, "People seem to want automobiles more than they want copper."

With a prospect of a dearth of fuel and lack of sufficient men for the coming fall and winter, and a marked advance in the price of copper unlikely, the immediate future would appear none too rosy, but, as we have already said, the resumption of dividends more than offsets the unfavorable factors. With the excellent management which the Michigan copper companies have, the difficulties will probably be surmounted and the depression of last year not soon repeated.

Recent Discoveries of Gold

REFERENCE was made recently in these columns to the reported discovery of a new gold field in South Africa. According to later information the scene of the rush is Nylstroom, 75 miles north of Pretoria and about 100 miles east of Deerspoort, on the border of Bechuanaland. This locality is near the Rustenberg district, south of the Crocodile River, which has yielded some placer gold in days gone by. Several prospecting parties are at work at Nylstroom, and some of the "big houses" are reported to have sent engineers to examine the discoveries. According to the *Financial Times* of London there is much prospecting activity in South Africa at this time. A few weeks ago a discovery of "banket" was announced in the eastern part of the Transvaal on the Swaziland border. Another tall story comes from German Southwest Africa. We hope that some of these diggings will prove to be the beginnings of a new departure in South African mining, for it would give a fillip to mining the world over.

The Herrin Affair Again

BY T. A. RICKARD

I HAVE received several letters on this subject in consequence of my article, appearing in our issue of July 22. The hope was expressed then that the promise of the Secretary of Labor, to prosecute the perpetrators of that brutal outrage "to the fullest extent of the law", would be fulfilled, especially as the public statement made by the Secretary was published "after consultation with the President". Mr. Harding himself made no reference to the matter until August 18, when, in a message to Congress, he spoke of the "pitiable sense of Federal impotence to deal with the shocking crime at Herrin, Illinois, which so recently shamed and horrified the country". He proceeded to say: "In that butchery of human beings wrought in madness it is alleged that two aliens were murdered. This act adds to the outraged sense of American justice and humiliation which lies in the Federal government's confessed lack of authority to punish unalterable [probably 'unutterable'] crime". Thereupon he asked Congress to enact legislation that would empower the Federal government to protect aliens and enforce treaty rights, that is, the rights of aliens as guaranteed in treaties with the governments of foreign countries. This refers to the Kellogg bill, now before Congress. This matter, as the President remarked, has been presented to Congress many times on the initiative of various past-Presidents, from Tyler to Taft, without result, largely on account of the opposition of organized labor. Similar opposition is promised again, for, on August 22, Mr. H. E. Wills, executive representative of the Brotherhood of Locomotive Engineers, described the Kellogg bill as "the most dangerous proposition that has been brought to our attention for some time". The objection, of course, is that any law enabling the Federal government to protect alien labor employed in the place of strikers would enable the Government to act effectively in the punishment of those responsible for the brutalities incidental to what euphemistically is termed industrial warfare. Does it not seem anomalous that the "butchery of human beings", to quote the President, should not stir constituted authority into action unless among those human beings are included the citizens of another country, whereas our citizens must depend on the protection of the State government, which, as in Illinois, is supine. On this phase of the subject I commend an article by a distinguished writer, Miss Agnes Repplier, in 'The Independent' of August 19. She refers to a speech made by Senator King of Utah on July 30—nine days after the Herrin massacre—in which he addressed a mass meeting at Philadelphia upon the familiar subject of Turkish atrocities. A day before this meeting a negro wrote a bitter letter to the press suggesting that the nation that tolerated lynching in the Southern States had no call to be concerned over the misdeeds of the Turks. But, says Miss Repplier, "how is a member from Illinois going to help discipline in the South when his State has given an example of wholesale lynching, more brutal, more bloody, more shameless than anything Georgia has ever known"? At Herrin the murdering did not take the exact form of lynching; it was even more savage and horrible. I need not repeat the details. Therefore Miss Repplier concludes: "If the States refuse to punish the crimes of

their sons, the Government has no final alternative. It will have to do the punishing". That can not be done, except possibly as regards the ill treatment of aliens by authority of a new law, because it would trespass upon State rights, under which, by the Constitution, the maintenance of order and the punishment of crime in a State is the privilege of the individual State, unless it confesses its inability to enforce the law and of its own accord asks the Federal government to interfere. The government of the State of Illinois has not asked for the assistance of the Federal government. Unfortunately at the date of the Herrin massacre the Governor of Illinois was under trial for fraud. The initiative lay with the Sheriff of the county of Williamson, in which Herrin is situated. He did not ask the Governor to send the State militia to assist him in maintaining order locally or in apprehending those responsible for the atrocity at Herrin. The community was, and is still, under the thumb of the labor-union. The coroner's jury enacted a farce and found that the death of 19 non-union men was due to the act of the officials of the coal company in hiring armed guards. The District Attorney should have taken action, but he also, it appears, was terrorized by the union. This is a state of affairs not uncommon; either the District Attorney is the henchman of the unions or he is the protégé of the other side, the companies. Justice is thwarted by corrupt politics. The next step would have been for the County Judge to ask, not order, the District Attorney (who is prosecuting attorney for the County) to take action, but he also, one must infer, was no free agent, fearing to lose his job at the next election if he did anything adverse to organized labor. Next the inertia of these County officials might be overcome by the Grand Jury, which could investigate and find indictments without regard to the Judge and District Attorney, but this was not done until a few days ago, two months after the event. So the county of Williamson and the State of Illinois join in dishonoring democracy. Further, the President of the United States has to throw up his hands, not only in horror but in impotence, acknowledging his inability to do anything, except possibly eventually to investigate the death of the two aliens that were among those murdered at Herrin, Illinois, on June 21, 1922.

Is this not a shameful state of affairs? Let me quote our Chief Executive again: "Had it [the Herrin massacre] happened in any other land than our own and the wrath of righteous justice were not effectively expressed, we should have pitied the civilization that would tolerate and sorrowed for the government unwilling or unable to mete out just punishment. I have felt the deep current of popular resentment that the Federal government has not sought to efface this blot from our national shield, that the Federal government has been tolerant of the mockery of local inquiry and the failure of justice in Illinois. It is the regrettable truth that the Federal government cannot act under the law". Then in the names of Alexander Hamilton and John Marshall let the nation that passed an amendment to the Constitution to check the ravages of alcoholism pass another amendment to check the worse ravages of industrial war.

DISCUSSION

Aims of the A.I.M.E.'s Committee on Milling Methods

With the Co-operation of the U. S. Bureau of Mines, It Is Working Out a System of Standardization Fundamentally Necessary to the Interpretation of Technical Practice

THE EDITOR:

Sir—A statement appearing in your issue of July 29, in which you mention my connection with the work that is being done upon the drill-steel problem, requires amendment, since it concerns the Committee on Milling Methods of the American Institute of Mining and Metallurgical Engineers, to which I am giving my entire attention as secretary of the committee while representing the U. S. Bureau of Mines in its activities.

The work now in progress by the Milling Committee is based upon a somewhat extensive program, the primary aim of which is the improvement of methods in milling practice, where assistance seems to be required. This will come about through the encouragement of all industrial influences that lead toward a betterment of practice. The immediate aim, which will be given much attention during the coming year, will be to survey the fundamental problems that have arisen in milling practice, and to determine, so far as possible, measures for best assisting the industry.

The Milling Committee is a large one, composed of about sixty members, who are men of broad interests, engaged actively and eminently in the industry, and who are capable of representing milling in all its varied and larger affairs. Thus is brought into this work, done for the benefit of the public, a far-seeing and substantial opinion, which is expert upon the important issues of the practice. Under the chairmanship of Galen H. Clevenger, with Robert H. Richards serving as honorary chairman, with a small group of men at headquarters observing and acting upon the will of the committee, and with representation within its membership of all branches of the industry by men who are leaders in the thought of their special interests, this body should be able to assume responsibilities that are imposed by many needs of present practice.

The Milling Committee has become identified in the past year with the Committee on Pulverization of the National Research Council. The two committees may now be regarded as acting jointly in all deliberations. The joint committee, furthermore, is in close harmony with the Committee on Standardization, and is prepared to act constructively in co-operation with other highly representative bodies or groups that have similar aims.

The committee, in co-operating with the U. S. Bureau of Mines, has in view the advancement of industrial welfare, and national accomplishment in its largest aspect. In furtherance of the work, the Bureau is providing half the funds for the maintenance of a secretary, to serve the committee, who is held responsible to the Bureau and appointed to represent the one organization

to the other in undertakings that are proposed. Noteworthy support has come to the committee for the prosecution of this greater work from the Massachusetts Institute of Technology, which is providing office headquarters and highly valued clerical and laboratory assistance and the facilities of its magnificent libraries and equipment. Similar important assistance has come to the committee through the U. S. Bureau of Mines, from the University of California, which is providing generously for the part maintenance of the secretaryship of this committee during the present year. Help is coming also from many individuals.

At present, the committee is undertaking the standardization of certain important testing practices, such as the screen-sizing test. This test, as an instance, is fundamental to the interpretation of milling practice and requires standardization before certain of the improvements in the operation of milling can be estimated. The committee holds, also, as one of its important functions, the guidance and aid which it can render in securing the highest order of publications on the subjects of chief concern to the milling industry. The determination of prevailing opinion upon important terms that require agreement, to acquire the exactness necessary for technical use, is being brought to the judgment of this larger body. It is expected that the committee is to become an energetic factor in other undertakings directed toward the upbuilding of the industry and the advancement of welfare which should react beneficially upon all who are engaged in milling practice.

The committee looks to the goodwill of the entire industry, and expects the co-operation of every scientific and industrial interest that is striving for the betterment of American practice. ERNEST A. HERSAM.

Cyanide Leaching of Copper Ores

THE EDITOR:

Sir—In the *Engineering and Mining Journal-Press* of April 1 appeared some data supplied to you by a correspondent regarding the use of cyanide in the leaching of copper ores. Some errors are evident. Native copper is dissolved by cyanide; also, cyanide dissolves cuprous sulphide; as, for example, the chalcocite of Corocoro ores. Sulphide of sodium does not precipitate copper cyanide as copper sulphide: if this were true, cyanide would not dissolve our chalcocites or cuprous sulphides.

We (at Corocoro) are going to leach our ores with sulphuric acid, because that is the cheapest method.

Chile.

F. A. SUNDT.

[The statements to which objection is offered were qualified. Our correspondent stated that "native copper is not dissolved to any extent, and the sulphides only slowly and also with loss of cyanide . . . It is probable that copper might be precipitated from a cyanide solution as a sulphide by the use of sodium sulphide . . . This precipitation would be incomplete."—EDITOR.]

Native Copper Smelting in Africa

THE EDITOR:

Sir—The article by Sydney Ball on copper smelting by African natives must have been of special interest to those that have had experience in the examination of their old workings. The mines in the district mentioned are very numerous, as many as seventy having been found along a ridge only $2\frac{1}{2}$ miles long.

It is not my intention to go into the general geology of the area, but a few words concerning the old workings may be of interest. These occur chiefly in a thick series of limestone and dolomitic rocks, which correspond to F. E. Studt's Kambove series, and which, in northern

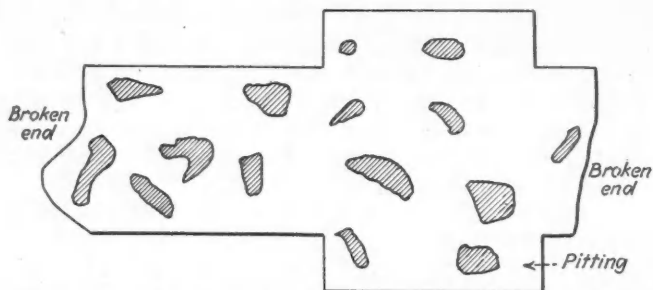


Fig. 1. Ancient copper cross, approximately actual size

Rhodesia, he has named the Broken Hill beds. They differ slightly in structural features, the well-defined cleavage of the northern territory being absent, but the faults in most cases are strike faults and in this correspond to the Kambove series. A coarse fault breccia, the result of the faulting, is a common feature, and in most places it has been impregnated by cupriferous solutions which have yielded deposits of ore varying greatly in size. The empirical rule is, the greater the dimensions of the faulted area the larger the deposit, but the largest developed has yielded less than 10,000 tons of ore and another "Star of the Congo" has yet to be found in this country. The old workings are confined to the brecciated zones, where, in places, they are mere pits, from 10 ft. in diameter and 15 ft. deep, to 50 ft. diameter and 40 ft. deep; whereas in others they are mere trenches, the width being extremely narrow in comparison with the length. No great depth was ever attained.



Fig. 2. An ancient copper tool

From observations taken in cleaning out over twenty of the workings, what appears to have happened is as follows: A sulphide vein has outcropped and been covered eventually by a film of one or more of the oxides, such as malachite or cuprite. A joint or other crack in the rock has allowed the rapid erosion of the last in a direction at an angle to the strike of the vein. As the vein weathered away pieces of it remained in the soil, and that portion which was taken into solution was precipitated as odd filaments of malachite here and there. All that is found after cleaning out is the smooth walls of the weathering country rock, and maybe the continuation of the sulphide vein. I have never seen any sign of ancient "rock-burning."

¹F. E. Studt: "The Geology of Katanga and Northern Rhodesia." *Trans., Geol. Soc. S. A.*, Vol. XVI, pp. 44 to 106, 1913.

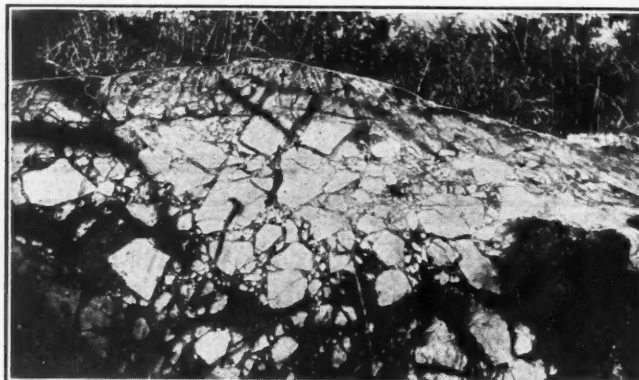


Fig. 3. Coarse breccia forming one of the sides to an old working

It is generally believed that the treatment of sulphide ore was beyond the ken of the native metallurgist, and as soon as his small patch of oxidized material was finished he would have been forced to leave his mine, however good the indication of further bodies of sulphide ore was.

The methods of reduction used by these ancient people were not so simple as to allow the erection of a smelter wherever they found the ore; only in one instance has one been discovered in close proximity to any sign of copper. That deposit, by a strange coincidence, was never touched, and it is not surprising, for it is merely paint malachite and azurite over a large outcrop of limestone. Rather are the smelters found at a considerable distance from the workings, but the reason for this can only be guessed—perhaps the need of being close to a particular wood for the charcoal, or a particular clay for the erection of the plant, outweighed the cost of the transportation of the ore.

The modern native's efforts to help one in gathering ideas concerning the process are painful, for in questioning him, he tries to guess at what one would have him say, and says it! He knows nothing of the ancient art, and I find it extremely difficult to believe that his



Fig. 4. A native smelter

progenitors did; to some race further north and of a less woolly nature must we look in our search for the ancient prospectors.

Two manufactured articles have been found: one a cross of the design shown in Fig. 1, and the other what might have been meant for a spear, as will be seen from the sketch, Fig. 2. An assay was made of the last article; 98.68 per cent of copper was found, with only a trace of silver, a significant fact, for all the sulphide ores carry at least 5 oz. per long ton. The smelter shown in the photograph, Fig. 4, which was taken by me during 1919, is one of a pair, but its fellow is not in such good condition.

Although it is true that large trees are found growing in the old workings, the fact that one of the furnaces is still standing points to no very distant date when these ancient operators were in the country. In my own experience I have known a tree to grow to quite a size in Africa within ten years.

Iron smelting is still practised, chiefly by a tribe called the Bankoya, who live about 100 miles west of this property. The hoes they produce are much sought after by less gifted natives in other districts, and a few white traders have turned this fact to profit by stocking the local article in preference to that from Birmingham. To purchase them they have to go to the Bankoya country, taking with them various trade-goods. The raw ore (a high-grade hematite) is purchased at so much a basket (60 to 70 lb.), handed over to the local smithy, who works on contract, and the trader does a fortnight's shooting² while his hoes are being made. He is able to sell them for as much as 15s. apiece, compared with 4 to 5s. obtained for the imported article.

R. MURRAY-HUGHES.

Sable Antelope Mine, via

Mumbwa, Northern Rhodesia, Africa.

An Engineer's Patents

THE EDITOR:

Sir—Mr. John Boyle, Jr., expresses an interesting point of view on patents, in your issue of Aug. 12, 1922. It is difficult to harmonize Mr. Fish's statements (which he quotes) that not one patented invention in ten is worth working, and that inventors get well paid. Of course, some inventors are well paid, but the law of averages should prevail. The inference seems to be that there is a waste of time and money in useless inventions. Most inventors are probably aware of this, but the knowledge of it is not of any great advantage.

Emerson, in one of his famous essays, deplored the waste in education and said he did not believe in educating fools at college. No one would be inclined to quarrel with Emerson about that, but what most of us would like to know is how to distinguish the fools. He did not tell us that. And so, what inventors would like to know is how to distinguish the failures in advance.

Every prospector, for example, thinks his hole in the ground will make a mine, and practically all prospects have been repeatedly condemned at some time by expert mining engineers. Prospectors are quite aware that only about one out of every hundred holes in the ground makes a mine, but they have no way of telling which the fortunate hole will be. Every inventor thinks his ideas will lead to some improvement, and every metallurgical process has been repeatedly condemned by some

metallurgical experts. Metallurgical inventors are usually aware that fully 95 per cent of all patents are incapable of immediate practical application, but they have no way of telling in advance which the more promising 5 per cent will be. Yet it is due to the small percentage of successes that mining and metallurgy have assumed the proportions that they have today. The progress of the world is more indebted to the faith of fools than to the prophecy of the wise.

When was flotation a success and when a failure, based on the patent situation? When Carrie Everson claimed, "The method which consists in mixing pulverulent ore, a fat or an oil or a constituent thereof (animal, vegetable, or mineral), an acid or soluble neutral salt, and water, etc.," she conceived the essentials of a great invention. Similarly, when Kirby stated his process to consist in agitating (with gas) pulverized mineral matter, enough water to make a flowing pulp, and a solution of bitumen in a thin distillable hydrocarbon liquid, he also disclosed the elements of a great invention. Both Everson and Kirby disclosed the essentials of flotation, but their patents must be considered as failures, as well as other similar patents up to the time of the filing of the M. S. patent No. 835,120, May 29, 1905, which had more to do with kind and degree rather than with essentials, and even after the M. S. patent was filed, there was no certainty for many years that the M. S. patented process would be a success. Even after thirty-seven years the flotation situation is obscure.

Mr. Fish refers to inventors as being eccentric. It is no doubt true that many of them have exaggerated opinions of their own inventions. No man can accomplish anything unless he has faith in his own efforts. This is true of all avenues of human endeavor, and is not peculiar to inventors. We probably all are inclined to have exaggerated opinions of ourselves, while our best friends and our best enemies may think we are fools, and sometimes we suspect that they are not far from the truth, but it would be fatal to our progress to admit it. We all like to chase our "favorite phantoms." If the phantom a man chases is a high political office, he is aspiring; if the phantom he is chasing is the dollar, he is practical; if the phantom he is chasing is an invention, he is eccentric. Perhaps Mr. Fish can tell us the difference.

WILLIAM E. GREENAWALT.

Denver, Colo.

Loading Dynamite

THE EDITOR:

Sir—I was interested in the article entitled "The Do and Don't of Loading Dynamite," in the Aug. 12 issue of the *Journal-Press*. In this article it was stated that the proper way of loading dynamite is "with the cap in the top of the top cartridge, pointing down toward the bulk of the charge, with lots of tamping and no part of the fuse touching the powder." If this method is practiced at all in the Jerome district, I do not know about it. On inquiry I have learned that the most favored way of loading a hole is with the cap in the next to the top cartridge. I understand that with the powders used nowadays there is no danger of their being ignited by a side spit of the fuse. Moreover, if the cap is put in the top of the top cartridge, it is likely to blow out, even through a certain amount of tamping.

J. L. FEARING, JR.

Jerome, Ariz.

Mining Geologists of Note

GEORGE H. GARREY

GEORGE H. GARREY is a native of the Badger State, having been born in 1875 at Reedsville, Wis., where his father was a physician and surgeon. Of American of Scotch-Irish descent, he spent his boyhood at Stockbridge and Wausau, Wis. Later his parents moved to Aurora, Ill., where he attended and graduated from the West Aurora high school. He then entered the University of Chicago as a student in the scientific course and paid most of his own way through college by working at twenty cents per hour upon "student service work" in the libraries or offices of the university to pay two-thirds of his tuition fee of \$120 per year, and then made up the major portion of the balance of his expenses by tutoring, lighting street gas lamps, or doing any odd jobs that turned up. He also found time to play football upon the first team of the university for three years. Mr. Garrey has to thank Prof. Rollin D. Salisbury for inducing him to specialize in geology during his last two years as an undergraduate. From 1898 to 1900 he was teacher of science in his home high school at Aurora, but returned to

the University of Chicago in the fall of 1900 for graduate work in geology, in which he received a scholarship. Mr. Garrey is a member of Phi Delta Theta, a charter member of Alpha Nu, and also Sigma Rho. In the summer of 1900, accompanied by Eliot Blackwelder, he was on U. S. Geological Survey work in western Montana, northern Idaho, and eastern Washington. This work was used as the basis for the thesis submitted to the University of Chicago faculty and for which he was granted a Master of Science degree in economic geology. During 1901 and the spring of 1902 Mr. Garrey was in charge of field classes in geology and an instructor in petrology at the University of Chicago and spent the summer of 1902 working as an ordinary miner and laborer in the mines and mills of Leadville, Colo. He then entered the Michigan College of Mines, and in April, 1904, received the degree of Engineer of Mines. Immediately after this he received an appointment upon the U. S. Geological Survey as an economic geologist to assist J. E. Spurr. While connected with the Geological Survey, he was

co-author with Spurr and Ball of the "Ore Deposits of the Georgetown, Idaho Springs, and Empire, Colorado, Districts," in Professional Paper 63, by Spurr, Garrey, and Ball; associated with F. L. Ransome and W. H. Emmons in the preparation of Professional Paper 66 on the

"Goldfield, Nevada, Mining District," and the U. S. Geological Survey bulletin on the Bullfrog and Rhyolite, Nevada, mining districts, and joint author with W. H. Emmons of the bulletin on the Manhattan, Nevada, mining district. In the fall of 1906 he resigned from the U. S. Geological Survey to act as first assistant to Mr. Spurr, who then held the position of chief geologist to the American Smelting & Refining Co. and allied companies. Early in 1908, J. E. Spurr, W. Rowland Cox, and Mr. Garrey resigned their positions and went into partnership under the firm name of Spurr & Cox, Inc., consulting mining geologists and engineers. Mr. Garrey was one of the officials and southwestern manager of this firm in charge of their El Paso, Tex., and Mexico City offices. After the spring of 1911, Mr. Garrey and J. E. Spurr continued consulting work. In 1911



GEORGE H. GARREY

Mr. Garrey became chief geologist for the American Smelting & Refining Co., the American Smelters Securities Co., the Guggenheim Exploration Co., and the allied companies. As this involved examination of mines in Mexico at various periods of the Madero and Huerta revolutions, Mr. Garrey and the engineers who were assisting him underwent some trying times and upon two occasions had difficulty in getting out of Mexico. Early in 1914 he again opened an office as consulting mining geologist and engineer, and continued on this general consulting work until 1916, when he accepted the position of consulting geologist and engineer in charge of the exploration department of the Tonopah Belmont Development Co. This work involved the examination of numerous mining properties presented for purchase and also the outlining of development work for the company and its subsidiaries. He is a member of the Mining and Metallurgical Society of America, A.I. M.E., Society of Economic Geologists, Washington Academy of Science, and Geological Society of Washington.

Determining Relative Tonnages from Assays

Inconsistent Equations Due to Errors in Sampling and Assaying—Simple Graphical Method Advocated Shows When These Need Attention and Gives Close Approximation to True Figures

BY ALFRED T. FRY

ARTICLES on the subject of this paper have appeared in the *Mining & Scientific Press* by A. H. Heller on April 17, 1920, and by H. R. Robbins on Sept. 18, 1920. In both of these the treatment is mathematical, and inasmuch as each product is assayed for several metals, ample data are given, and no trouble might be expected. But it sometimes happens that in the preparation of these assays our friends, the sampler and assayer, have had troubles of their own, which are reflected in the resulting figures. In 1916 I came across a case [lucky man] where a comparatively small error in assays made a relatively large error in an attempt to calculate recoveries from them. As a result I devised a method which I shall presently describe and which has been tested by friends and found of value.

The instance arose during the flotation treatment of a complex lead-zinc ore containing pyrite and silver. The ground ore was subjected to flotation in two stages. Stage one brought off a pyrite-galena concentrate, and its tailing formed the feed of stage two, in which a blende concentrate was obtained and the final residue was made.

Samples were taken of 1, original feed; 2, pyrite-galena concentrate; 3, tailing from first stage forming feed to second stage; 4, blende concentrate; and 5, residue. Assays for zinc, lead, and silver were made on all samples.

A TYPICAL ANALYSIS FOR ILLUSTRATION

To illustrate, I will take an assumed case—based closely on practice—in which every fact is known, as follows:

Per Cent by Wt.	Assays			Ag. Oz.	Contents			Per Cent Metal Distribution		
	Zn, Per Cent	Pb, Per Cent	Ag, Per Cent		Zn	Pb	Ag	Zn	Pb	Ag
Feed	31.85	11.34	13.2							
P.-G. Conc.	40	9.1	21.4	25.1	364	856	1,004	11.4	75.5	76.1
Intermediate (60)	47.02	4.633	5.27							
B. Conc.	50	56.2	5.4	6.2	2,810	270	310	88.3	23.8	23.4
Residue	10	1.1	0.8	0.6	11	8	6	.3	.7	.5
					31.85	11.34	13.20	100.0	110.0	100.0

To avoid making an unduly bad example, the sampler will be absolved from suspicion by supposing that his part of the work is performed perfectly. Next, suppose that the assays were subject to slight errors such as may be found in results obtained on mill products where purchase-work accuracy is not always attained. Thus, assume some assays to be reported 0.1 per cent high and others 0.1 per cent low, except for the blende concentrate, where an error of 0.2 per cent is taken. Such errors easily arise from faulty weighing, spattering, bad separation, filtration or washing, or inaccurate standards.

The reported assays are then:

	Zinc Per Cent	Lead Per Cent	Silver, Oz.
Feed	31.8	11.3	13.3
Pyrite-galena concentrate	9.0	21.3	25.0
Intermediate	47.0	4.6	5.2
Blende concentrate	56.0	5.4	6.3
Residue	1.0	0.7	0.7

There are three ways of dealing with these figures: *First*—Since the intermediate assay is available, the work can be considered as a single concentrate flotation performed twice, using the formula,

$$\text{Per cent weight concentrate} = \frac{100(F - T)}{(C - T)}$$

where F = per cent of metal in the feed,
 C = per cent of metal in the concentrate,
 T = per cent of metal in the tailing.

Second—If the intermediate assay were lacking it becomes a problem in simultaneous equations.

Third—A method of simple equations and graph devised by me in 1916, in which the intermediate assay is not required.

DETAILS OF THE THREE SOLUTIONS

First—Regarding the work as a single concentrate flotation performed twice, since the intermediate assay is given, the percentage of concentrate in each stage may be obtained separately by the old formula already mentioned, by which the calculation is easy.

Thus,

Stage 1—The zinc figures give per cent weight of P.-G. Concentrate = 40.0	
The lead figures give per cent weight of P.-G. Concentrate = 40.1	
The silver figures give per cent weight of P.-G. Concentrate = 40.9	
Average.....	40.3

Therefore the per cent weight of tailing going to the next stage is 59.7 per cent.

Stage 2—The zinc figures give per cent weight of B. Concentrates = 83.7	Per Cent
The lead figures give per cent weight of B. Concentrates = 83.0	
The silver figures give per cent weight of B. Concentrates = 80.4	
Average.....	82.37

Thus, 82.37 per cent of 59.7 per cent = 49.15 per cent, weight of blende concentrate. Therefore the per cent weight of the residue (100 — 40.3 — 49.15) = 10.55 per cent.

To determine the value of these results it will be necessary to work out the percentage distribution of metals, incidentally calculating "the derived feed assay" and comparing it with the reported assay.

Per Cent by Weight	Assays			Ag. Ounce	Contents			Per Cent Metal Distribution		
	Zn, Per Cent	Pb, Per Cent	Ag, Per Cent		Zn	Pb	Ag	Zn	Pb	Ag
Feed	31.8	11.3	13.3							
P.-G. Concentrate	40.3	9.0	21.3	25.0	363	858	1,007	11.4	75.9	75.7
B. Concentrate	49.15	56.0	5.4	6.3	2,752	265	309	86.5	23.5	23.2
Residue	10.55	1.0	0.7	0.7	10	7	7	.3	.6	.5
					31.25	11.30	13.23	98.2	100.0	99.4
					"Derived Feed Assay"					

The results are not quite happy, but are fair under the circumstances. As will be seen in the next method, these mathematical solutions are seriously upset by deviations of the reported assays from truth, giving inconsistent equations.

Second—Regarding the calculation as a problem in

simultaneous equations in which the intermediate assay is not required, the procedure will be,

Let X = per cent by weight of pyrite-galena concentrate.
 Y = per cent by weight of blende concentrate.
 Then 100 - X - Y = per cent by weight of residue. (Note. Since three sets of assays are given, the per cent weight of residue may be taken = Z if preferred.)
 Then from the
 zinc assays, $100 \times 31.8 = 9X + 56Y + (100 - X - Y) \cdot 1$ (1)
 lead assays, $100 \times 11.3 = 21.3X + 5.4Y + (100 - X - Y) \cdot 0.7$ (2)
 silver assays, $100 \times 13.3 = 25X + 6.3Y + (100 - X - Y) \cdot 0.7$ (3)
 or $3,080 = 8X + 55Y$ (1)
 $1,060 = 20.6X + 4.7Y$ (2)
 $1,260 = 24.3X + 5.6Y$ (3)

From (1) and (2),
 $37.6X + 258.5Y = 14,476$
 $1,133.0X + 258.5Y = 58,300$
 $1,095.4X = 43,824 \therefore X = 40.007$ per cent
 (1) and (3),
 $44.8X + 308Y = 17,248$
 $1,336.5X + 308Y = 69,300$
 $1,291.7X = 52,052 \therefore X = 40.2$ per cent
 (2) and (3) =
 $115.36X + 26.32Y = 5,936$
 $114.21X + 26.32Y = 5,922$
 $1.15X = 14 \therefore X = 12.1$ per cent

The last result is a good instance of the collapse of mathematical treatment of inconsistent equations. Of course it is no use to carry the calculation further.

Third—Fry method: Take two examples, in the first of which temporarily assume a value for the per cent weight of residue which is less than the probable, and in the second instance, more, i.e., (a) 5 per cent, and (b) 15 per cent.

Take X = per cent pyrite-galena concentrate by weight.
 Then (a) the per cent weight of blende concentrate = $100 - 5 - X$
 (b) the per cent weight of blende concentrate = $100 - 15 - X$

By using both examples for the assays of each metal six simple equations are obtained, thus:

zinc (a) $31.8 \times 100 = 9X + 56(95 - X) + 5 \times 1$ $X = 45.6$ per cent
 (b) $= 9X + 56(85 - X) + 15 \times 1$ 33.9 per cent
 lead (a) $11.3 \times 100 = 21.3X + 5.4(95 - X) + 5 \times 0.7$ 38.6 per cent
 (b) $= 21.3X + 5.4(85 - X) + 15 \times 0.7$ 41.6 per cent
 silver (a) $13.3 \times 100 = 25X + 6.3(95 - X) + 5 \times 0.7$ 38.9 per cent
 (b) $= 25X + 6.3(85 - X) + 15 \times 0.7$ 41.9 per cent

Construct a small graph with X per cent as ordinates, and per cent residue as abscissæ.

Note that the zinc line gives two intersections, one with the lead and the other with the silver line. Mark the mean of the two intersections and read off the corresponding percentages of pyrite-galena concentrate and residue (40.1 per cent and 9.65 per cent respectively). If the figures were free from errors, of course there would only be one point of intersection for the three lines.

Calculating metal distribution and "derived feed assay" as before:

Per Cent by Wt.	Assays			Zn	Pb	Ag	Zn	Pb	Ag	Per Cent Metal Distribution		
	Zn	Pb	Ag							Zn	Pb	Ag
Feed	31.8	11.3	13.3									
P-G concentrate	40.1	9.0	21.3	25.0	361	854	1,003	11.3	75.6	75.4		
B. concentrate	50.25	56.0	5.4	6.3	2,814	271	317	88.5	24.0	23.8		
Residue	9.65	1.0	0.7	0.7	10	7	7	.3	.6	.5		
					31.85	11.32	13.27	100.1	100.2	99.7		

COMPARISON OF RESULTS

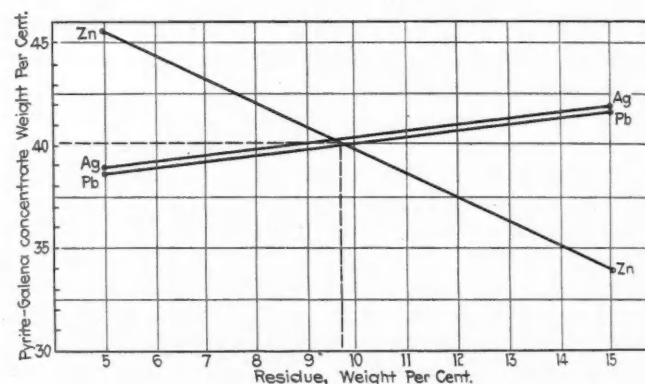
	Assay			Per Cent Metal Distribution					
	Zn	Pb	Ag	Pyrite-Galena			Blende Concentrate		
	Zn	Pb	Ag	Zn	Pb	Ag	Zn	Pb	Ag
Real distribution	31.85	11.34	13.2						
Formula method:				11.4	75.5	76.1	88.3	23.8	23.4
Derived feed	31.25	11.3	13.23						
Distribution				11.4	75.9	75.7	86.5	23.5	23.2
Simultaneous method:									
Feed									
Distribution									
Graphic method:									
Derived feed	31.85	11.32	13.27						
Distribution				11.3	75.6	75.4	88.5	24.0	23.8

The result of the foregoing is, taking a known example, and supposing the figures altered only by amounts possible as assay errors, i.e., 0.1 per cent or

0.1 oz. except in the zinc assay on blende concentrate where 0.2 per cent error is taken,

1. That when the intermediate assay is available, the work may be calculated by the formula quoted, but results are not dependable.

2. That calculation by simultaneous equations is sometimes completely deranged by small errors in the figures.



Graph illustrating third method

3. That the graphic method illustrated gives a close approximation to the real figures.

4. The graphic method is simple and definite.

5. It shows strikingly when errors in sampling and assaying need attention.

Assays of silica, sulphur, iron, and sometimes "insoluble" may be used in a similar way.

Mining in the Federated Malay States

In a pamphlet recently issued on mining in the Federated Malay States, attention to which is called by the Malay States Information Agency, London, it is claimed that it is possible to indicate within a reasonable degree of probability what the trend of mining there is likely to be. "As the major portion of the rich alluvial flats in the Federated Malay States has already been worked," it says, "successful mining becomes more and more a matter of fine adjustment of costs and cheap power, the controlling factor being the price of tin. When the world has resumed its normal powers of consumption, one may expect to find the price of tin gradually rising owing the increased consumption and decreased output. With the possible exception of China, which is popularly credited with vast stores of most of the valuable minerals, no new tin fields are known or even suspected, and tin may eventually reach that price at which it will pay consumers to use a substitute.

"As regards the mining in this country, it will, no doubt, tend more and more to large-scale working of poor deposits. It is quite conceivable that much of the ground already dredged will be dredged again. New and cheaper methods of working on a large scale may be introduced. With the exhaustion of the flats the hills will be explored; not by the hand-to-mouth methods now employed by the Chinese, but with the help of ample and cheap power, by pumping water at a high pressure through 'monitors,' washing down all the decomposed ground, extracting the ore, and dumping the detritus in huge dams built on the worked-out flats below. This will inevitably lead to the exposure of any lode or lode-like formations there may be in the rock.

An Illustrated History of Mining and Metallurgy—III*

In the Middle Ages—Methods Practiced Described by Biringucci—Amalgamation Process Applied to Ores—Treadwheels Used for Hoisting—An Early Mine Car

BY H. H. MANCHESTER

WHEN THE BARBARIANS overran the Roman Empire in the west, the great Roman mines which depended for their operation upon important engineering works were abandoned, and mining in general practically ceased for a century or so. It is doubtful, however, if it was stopped entirely, but where continued it was carried on in a much more primitive way.

The barbarians themselves, even before they were Christianized, did some mining. The still pagan Avars,



A miner of Dieselmount, about 1300 A.D.

for example, about 550 A.D. opened up the electrum mines of Kremnitz, and the silver mines of Chemnitz and Transylvania. In the seventh century the barbarians began to mine silver at Rothansberg, in Bohemia, and in the eighth century the un-Christianized Saxons started mining at Zell and Andreasberg. In England, also, the streams at that time were dug up for tin, though no actual mines for this metal seem as yet to have been dug.

What is probably the remains of a barbarian smelter has been discovered in the Pyrenees. It was only about 2 ft. in height, the lower half being a cylinder, and the upper half an inverted cone placed over it. Two blast pipes entered about a foot from the bottom. Near by were found lumps of iron weighing from 30 to 35 lb. Sometimes the furnaces were placed on the edge of a hill where the wind was usually strong. Below the top of the hill was an opening where the wind could enter to blow the fire, while the top of the furnace had another opening above the hill.

It must be remembered, however, that the Dark Ages of Europe were the most brilliant ones of the Mohammedan realms. In the eighth century, for instance, the Mohammedans worked not only the gold and silver but the iron mines of Spain.

At some unknown date during the early Middle Ages, a highly interesting improvement was made in the

blast furnace. This was the Catalan forge, which is reputed to have originated in Catalonia, Spain. Water power was practically inexhaustible in the district, and was applied to blowing the furnace.

The water from a rivulet was caught in a small reservoir just above the furnace, and after the furnace was lighted the water was permitted to run down a pipe at the back of or underneath the furnace. The moving water sucked air down with it, which escaped through a hole in the pipe below the furnace and acted as a constant blast.

One of the first of the mediaeval writers who touched on metallurgy was Theophilus, the monk, about 1,100 A.D. In his volume on the various arts he considered the purifying of silver and copper, and the separating

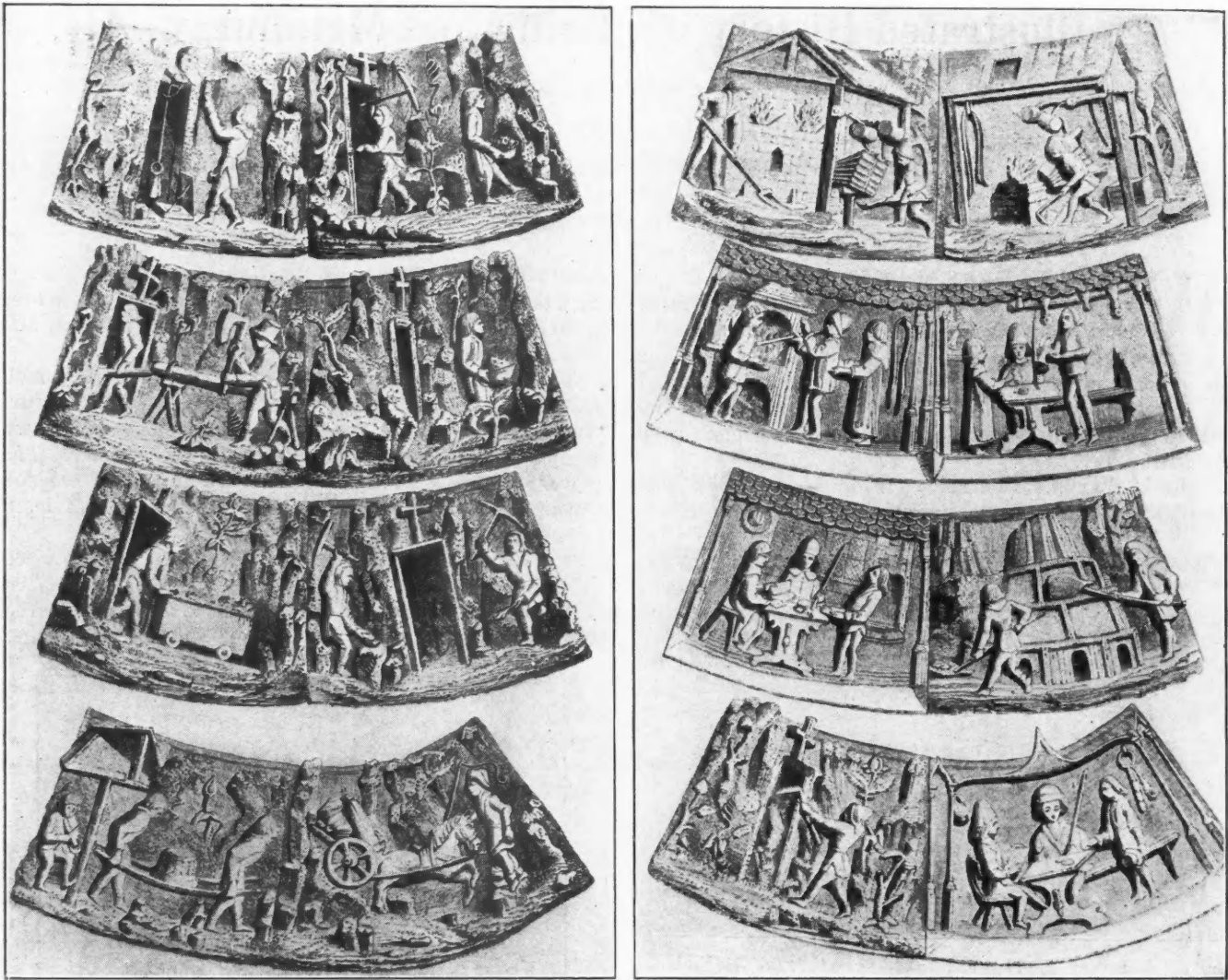


A miner of the thirteenth century

of gold from silver or copper. His account of the separating of gold and silver as done by goldsmiths, runs as follows:

"Place the scrapings in a small vessel such as gold or silver is melted in. Press a small linen cloth over it so that nothing may be ejected from it by the blast of the bellows. Then melt them by placing it before the furnace. Thereupon lay fragments of sulphur in the molten metal according to the quantity of the scrapings, and carefully stir it with a small piece of charcoal until the fumes cease. Then at once pour out into an iron mold. Beat it upon an anvil gently lest some of the black may fly from it, because this is the

*The third of a series of four articles. The first and second articles of the series were published in the issues of Sept. 2 and Sept. 9 respectively.



Mining and smelting scenes of about 1400 A. D., from a silver vase

silver which the sulphur has burnt. The sulphur consumes none of the gold, but only the silver which it separates from the gold which you carefully preserve. . . . Place all the black upon bone and ashes, and adding lead burn it so that you may recover the silver."

Marco Polo, who visited the Far East about 1,300 A.D., mentions a number of gold and silver mines there, but tells nothing of the processes used. In passing, he mentions that in central Asia gold was then worth six times as much as silver. The only operation related to smelting that is mentioned by him is his account of the preparation at Cobinan of an impure oxide of zinc. This runs as follows:

"They have a vein of a certain earth which they put into a great flaming furnace, whilst over the furnace there is an iron grating. The smoke and moisture expelled from the earth adhere to the iron grating and form tutta, whilst the slag that is left after burning is the spodium."

During the Dark Ages the Graeco-Roman cylindrical furnace was forgotten, but was revived again in the thirteenth century in the stack oven which came into use along the Rhine. This was perhaps 10 ft. tall, with two holes near the bottom for the blast.

The most interesting set of pictures concerning mining and metallurgy is a series engraved on a silver vase by the gold and silver smiths of Gand, France, about 1,400 A.D. It consists of sixteen scenes arranged around the vase. In the first scene, a saint's head is

pictured over the mouth of the mine, representing no doubt the saint to whom the mine was dedicated in the hopes of warding off misfortune. The second scene represents one miner with his pick just entering the mine, which now has a cross over the top, while another miner is apparently carrying out some of the ore. The third view illustrates the making of wooden props. The fifth scene is remarkable as showing a small car filled with ore, and apparently being pushed along on wooden rails. If this is correct, it is the earliest picture of a car on rails yet brought to light. The sixth scene shows the breaking up of ore, while the next two depict different methods of transporting it.

The ninth to the eleventh scenes, inclusive, represent different furnaces and processes in smelting the ore. Two of these cuts prove that waterwheels were already in use for working the bellows. Another smelting operation is depicted in the fourteenth scene. Here the furnace is higher, and there is no sign of bellows being used. Three of the other views symbolize the business transactions of the silversmiths, while in the remaining view we see the miner once more entering his mine.

BIRINGUCCI DESCRIBES MINING IN EUROPE

Some conception of mining in Europe may be obtained from the Italian work on pyrotechnics by Biringucci. This was written chiefly to demonstrate

the casting and boring of cannon, but leads up to this by means of accounts of mining and metallurgy. In his directions for mining, Biringucci advises that after the signs of ore are discovered, the mine should be begun not at the top of the hill, as in ancient times, but at the bottom of the hill by means of a passage running horizontally to where it is calculated that the lead is located. Near the entrance of the cave he directed dormitories to be built for the workmen, and

a storehouse for their necessities; also a smith's forge where the worn and broken tools could be renewed. After these preliminaries, Biringucci continues:

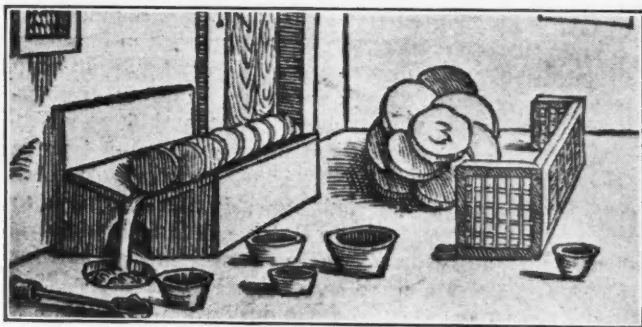
"Thus in the name of God and good adventure, causing a priest to bless the mountain with all the shops, and to baptize the cave, dedicating it as the manner is to the Holy Trinity, or our Lady, or to some other saint which you have in mind, with the invocation to them to prosper your attempts, you shall with good courage and hope begin to dig the cave."



A mine and near-by smithy, from Biringucci



Assaying in 1540, from Biringucci



Liquating furnace and cupellation cups, 1540



Grinding ore in amalgamation process, from Biringucci



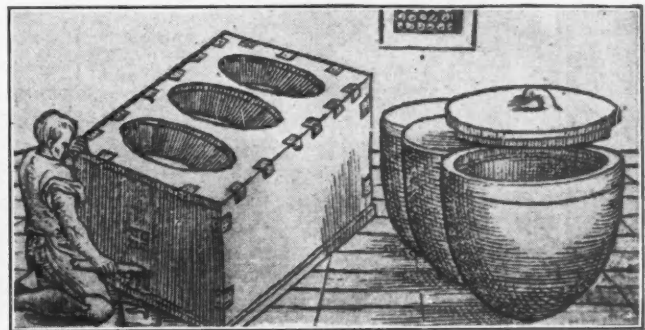
Miners' tools, from Biringucci



A silver furnace, 1540, from Biringucci



Preparing to reduce quicksilver, from Biringucci



Furnace for quicksilver, from Biringucci



Smelting arrangements, from Archbishop of Upsala

Where the cave ran through soft material, Biringucci admonished:

"Use all possible diligence in upholding and strengthening the cave well with arches of walls traversed with strong posts of timber after the manner of framed beams, sustained with great and strong piles made of good durable timber of oak or other great trees."

Biringucci suggests shifts of fresh workmen every six or eight hours. In regard to the tools in use he says:

"For the digging of such mines as are found in dead and tender stones, as alabaster and marle, it is requisite apt and strong instruments, as great beetles, mattocks and spades of iron, also great and long crowbars of iron to lift great boards; likewise large and small pickaxes, some of iron and some of steel. Furthermore, there should be great mauls with and without handles, and such other tools both of iron and fine hardened steel as the hardness of the stone shall require. . . . Besides these it will also be requisite to have plenty of great baskets, spades, shovels, sleds, hand barrows with and without wheels; and sacks made of raw or untanned hides to carry the fragments out of the cave."

The light was supplied from various materials, as may be seen from the following directions:

"Have great quantities of unctuous liquors to maintain fire, such as the oils of olives, nuts, linseed, and hempseed; likewise have roots of rotten trees, or animal tallow, or the fat and oil of fishes. For without the light of fire it is not possible for the laborer to work."

Without knowing the reason, the miners of the time recognized the necessity of fresh air to fire, for Biringucci added:

"Nor can any fire be maintained in the cave except it receive the air through some 'respiracle' or breathing place, by means of a funnel or trunk of wood, or such other open pipe whereby the air may be conveyed into the cave."

Several remarkably interesting cuts illustrating mining in the middle of the sixteenth century are contained in the history of the northern countries, written



Swedish mine, sixteenth century, from Archbishop of Upsala. Note treadwheel for hoisting

in Latin by the Archbishop of Upsala. One of the cuts shows a large treadwheel in use at the top of the mine for hoisting the metal or the miners. Such tread wheels were in use in Roman times, but it is interesting to find them adopted as far north as Sweden.

In another cut may be seen a cave at the bottom of the shaft. On the left a miner is at work with his mallet and wedge. At the right is depicted the devil or one of the evil spirits of the mine causing a cave-in. To the artist this was no fanciful conception, for at the time it was universally believed that the mines were inhabited by demons, who caused the accidents which inevitably took place.

In regard to smelting Biringucci is even more informative of the advance made at that date.

The amalgamation of gold and quicksilver was known to the Romans, and was used by their goldsmiths in refining gold. Pliny, for example, wrote of it:

"All substances float upon the surface of quicksilver, with the exception of gold, this being the only substance that it attracts to itself. Hence it is, that it is such an excellent refiner of gold; for on being briskly shaken in an earthen vessel with gold, it rejects all the impurities that are mixed with it. When once it has thus expelled all these superfluities, there is nothing to do but to separate it from the



Interior of Swedish mine, sixteenth century. Note evil mine demon at right

gold: to effect which it is poured out upon skins that have been well towed, and so exuding through them like a sort of perspiration, it leaves the gold in a state of purity behind."

FIRST DESCRIPTION OF AMALGAMATION PROCESS APPLIED TO ORES

But the amalgamation process for separating gold from its ores, and especially for smelting silver, does not seem to have been used in ancient times, and the account of it by Biringucci is thought to be the earliest. His account is therefore worth repeating at least in part:

"He was surely endowed with much useful and novel genius, who invented the quick method of extracting metal out of the sweepings from those arts that work gold and silver, from the refuse of those materials and also from certain ores themselves, without the labor of fusing, but by the sole means and virtue of mercury. To effect this a large basin is first constructed of stone or timber and walled, into which is fitted a millstone made to turn like that of a mill. Into the hollow of this basin is placed matter containing gold, well ground in a mortar and afterwards washed and dried; and, with the above-mentioned millstone, it is ground while being moistened with vinegar, or water in which has been dissolved corrosive sublimate, verdigris, and common salt. Over these materials is then put as much mercury as will cover them; they are then stirred, for an hour or two, by turning the millstone, either by hand or horse-



Small crucibles of the early Middle Ages

Fig. 1. Crucible with triangular aperture and horizontal handle, 10 cm. high. Fig. 2. Top view of crucible shown in Fig. 1. On handle is figure of a fiddler. Fig. 3. Crucible from vicinity of Cologne, 1½ cm. high. Fig. 4. Top view of Fig. 3.

power, according to the plan adopted, bearing in mind that the more the mercury and the materials are bruised together, by the millstone, the more the mercury may be trusted to have taken up the substance which the materials contain. The mercury, in this condition, can then be separated from the earthy matter by a sieve, or by washing, and thus you will recover the auriferous mercury. After this, by driving off the mercury by means of a flask, or by passing it through a bag, there will remain, at the bottom, the gold, silver, or copper, or whatever metal was placed in the basin under the millstone to be ground.

"Having been desirous of knowing this secret, I gave, to him who taught it to me, a ring with a diamond worth 25 ducats; he also required me to give to him the eighth part of any profit I might make by using it. This I wished to tell you, not that you should return the ducats to me for teaching you the secret, but in order that you should esteem it all the more and hold it dear."

Biringucci also describes the cementation process for separating gold and silver. This consisted in brief of interlaying the metal with powdered brick, common salt, and occasionally a little green vitriol, and then baking in the furnace for twenty-four hours. But as this process was far less important than the amalgamation method, the more complete description may be omitted.

Important variations in the furnace, of which Biringucci seems to be the first to make mention, were the reverberatory and liquidation types which he recommended for use in treating ores and metals in certain cases.

This brings us in Europe to the middle of the sixteenth century, but in the meantime mining had already begun on an important scale in the newly discovered Western Hemisphere.

To be concluded

Thawing Frozen Gravel with Cold Water

Recent progress in the thawing of frozen gravel in placer mining is discussed by Charles Janin in "Technical Paper 309," just issued by the U. S. Bureau of Mines. Among his conclusions are the following:

The different experiments and work done in cold-water thawing demonstrate that under favorable conditions the process is an assured success. It is proving of great value to the gold-mining industry of the Far North and is encouraging investigation and exploitation of areas of frozen gravel that had been considered of too low grade for profitable mining.

Much remains to be learned regarding the best method of applying the water to the frozen ground. Undoubtedly further improvements will be made as work is attempted on a larger scale and operating costs will be reduced as better methods are developed.

A number of factors must be considered in judging the feasibility of any mining venture based on the thawing of frozen ground by the use of cold water. The most important factor, other than a high enough gold content and the general conditions governing successful dredging or mining operations, is that a large quantity of water delivered at small cost is required for thawing frozen ground by the method as now used. At the plant of the Yukon Gold Co. on Gold Run, where the ground was 25 to 30 ft. deep, 1,000 points were necessary to thaw the ground in front of a 7½-ft. dredge. Water for these points was furnished by a large pump delivering 3,000 to 3,500 gal. per minute. About forty-five men were required to operate the plant, set points, and perform other routine work. Thawing with cold water was practicable during only three months of the six months' season, and a supplementary steam-thawing plant was necessary in the early summer and late fall. This has been the experience of the Yukon Gold and other companies that have tried thawing with cold water.

Edward Pearce in his early experiments found it advisable to use steam in addition to water under normal temperature, but has since developed a method of artificial drainage to supplement the cold water applied by points. It is possible that a large plant might thaw enough ground in three months to last until the end of the dredging season, but the experience of the companies mentioned is that steam thawing is necessary at least in beginning operations in the spring. Ground that is thawed but not mined at the end of a season is generally frozen solid again during the winter and requires re-thawing.

The number and size of dredges will depend upon the size, depth, and character of the ground to be worked; the same considerations govern the size of a thawing plant, and to some extent the cost of thawing. The latter, however, will also depend largely on the quantity of water available and whether it can be delivered under natural head or whether pumping will be necessary.

It should be understood that on some creeks where mining is carried on, the water available during the greater part of the season would be insufficient to thaw ground for large-scale work, even though the available water was constantly re-used. The Yukon Gold Co. found that 3,000 gal. or more of water per minute was required to thaw ground ahead of a 7½-ft. dredge. Figures on the quantity of water required at other operations are not at present available.

It is obvious that when water under natural head is not available, or is obtainable only through a great outlay for the construction of ditches, the cost of pumping water in districts where labor and fuel costs are high might prohibit the profitable thawing of frozen gravels that assay low in gold.

The success of thawing frozen ground by the application of cold water (water at natural temperature) under pressure depends, therefore, on securing a large quantity of water that can be delivered to the ground at low cost.

Placering in Tropical Countries

Enterprises Often Fail Because of Difficulty of Controlling Water—
Much Damage from Cloudbursts—Dragline Dredging
Method Promises a Solution

BY A. D. AKIN

A CLOSE STUDY of placer-mining conditions in the tropical countries and under tropical conditions quickly reveals the reason why so few enterprises of this character have the success their tested values indicated. Many millions of dollars have been sunk in attempts to work placers in the tropics which promised, after extensive and careful examinations, to return fabulous sums in earnings. The cause of these failures is not always technical ignorance, nor the lack of sufficient knowledge of placer mining in other sections, nor lack of knowledge of the diversified methods of carrying on that class of mining. A considerable number of such failures, where the work was projected on a large scale, have been with properties which have been in the charge of engineers of known and unquestioned repute; some of them of extensive experience in this class of mining, but under other climatological conditions.

An investigation of these operations will in most cases reveal that the engineer in charge has gained his experience in placering in the temperate zone or in the Alaskan fields. Generally the supposition seems to have been, in engaging an engineer for the examination and layout, that if the candidate had had experience in placer work in any part of the world he was competent to undertake it at any other place. The peculiarity of this seems to lie in the—shall we say—gullibility with which the officials of a placer proposition in the making will accept this conclusion. These men, if metal miners, in seeking an engineer to direct the organization of a lode mine, will look for one who is familiar with the idiosyncrasies of the ores of the district in which it is proposed to operate. This is done from an intuitive realization of the fact that the district problems are peculiar to themselves and the man who is acquainted with them is capable of more valuable opinions and less liable to error in hypothesis than the man who is brought in from a foreign district.

Why an operator, or operating company, of a lode proposition will do this, and, when it comes to a placer, involving probably as much capital, take the first technician convenient, without regard to his former experience, apparently under the assumption that a placer is a placer and an engineer is an engineer, is beyond the ken of average man. Some people chant the old refrain that "a placer is the poor man's mine." So it may be, or may have been, but the average placer of today is a weighty technical problem, requiring the highest skill of the specialist, particularly when attempting to work low-grade gravel.

Every field has its particular problems of operation and value recovery, whether it be Alaska, California, Arizona, the north of Mexico, the south of Mexico, Honduras, or elsewhere, and the man who makes the greatest success of any of them is the one who has mastered the problem of that particular field or one of similar characteristics. The placers in low tropical altitudes, however, offer the most difficult problems of all,

and in them have been lost more dollars than in any other form of gravel mining.

Under the normal conditions prevailing in the tropics, particularly the mountain sections, none of the accepted theories may avail. Ascertaining values presents the same problem wherever auriferous gravel is found, but right there the similarity ends. In the northern countries the matter of water is generally nothing more or less than that of finding it and getting it to the gravel at the minimum cost, but in the tropics the problem is one of controlling the water which at seasons and on occasions comes in superabundance.

In the northern countries where placers are found, the supply of water is usually more or less constant during the working season, so that the operator generally has a fixed condition, within certain limits, to control, and he can make plans with a reasonable degree of certainty of their sufficing for any conditions which may arise. In some places where the supply is a question of availability, his problem is one of supplying so many inches per day, or shift. Given a source of fixed supply, this becomes simply a question of economy of transportation. But in the tropics an entirely different condition is met, for here we have a dry and a wet season, each of months' duration. The wet season is the direct cause of the failure of the greater part of attempts at placer mining made in those countries.

For convenience the examination of placer properties is carried on during the so-called dry season, and allowance is made for conditions of the wet season as based on the information gained from the local natives and from water marks. This former class of information, as some of us learned many years ago, and sometimes with sorrow, is absolutely unreliable on which to base any investment data.

MANY ENTERPRISES WRECKED BY CLOUDBURSTS

The water which in the dry season looks so good and so opportunely situated becomes a raging torrent or a sea in the time of rains and at almost all times is subject to cloudbursts which sweep everything before them. More than once, just as the unlucky argonauts have completed a long string of sluices, or have just made a dredge ready for operation, there has come rolling down out of the mountain passes the bore of a cloudburst, feet in height, rolling in its head boulders, tree trunks, and all the debris it could gather in its irresistible race to the lower levels. In a few minutes it is passed, but in its wake it leaves havoc, and the painstaking efforts of months are wiped out. If there were sluice boxes, they have gone into the reaches of the stream miles below, or have been smashed into splinters. If a dredge, it is generally landed high and dry somewhere away from the rich gravel, or is scuttled and at the bottom of the stream, with all of its working parts filled with sand and gravel, if not so injured as to be absolutely useless. Or, if other mining means have been employed, the wake of the flood leaves

filled pits, thousands of tons of barren gravel loaded onto bedrock that had been stripped down to recovery gravel, and in many instances whole bars moved, to find lodgment at, possibly, a distant point.

A concrete instance from each class may be illuminating. On the famous Guayape River, in Honduras, where apparently every foot is pregnant with values, no successful placer venture has yet developed. To be sure, some values have been recovered, but a balancing of books on the ventures will show much red ink. Many kinds of rigs for the recovery of values have been tried, but none of them have been able to withstand the rush of the waters. It must be understood that the Guayape gravels are very deep, and the constant shifting of their upper parts has to a large degree concentrated the values. Of the many attempts made to handle this gravel on a considerable scale, every single one has come to grief on account of the periodical cloudbursts and swelling of the stream in the rainy season.

VARIOUS METHODS TRIED ON GUAYAPE RIVER GRAVELS

The Guayape gained its reputation in the early viceroyal days when the bench bars were in the main unworked and the Indians of the section that it traverses had gathered and stored up much gold which they had washed out bit by bit, even as their descendants are doing today. The early Spaniards, or, rather, the Indians whom they enslaved for the task, gathered immense amounts of the yellow grains from the bench bars and the workings along the river where the gravel was reasonably shallow, but no white man since their time, with one exception, has ever made any appreciable amount of money out of the Guayape placers. The exception is Fred Bell, and he is frank enough to acknowledge that he did not make the greater part of his money by direct effort in recovering values, but by purchasing gold from the local Indians, who are inveterate and skillful washers with the *batea*, or wooden pan.

Except for a dredge, practically every known method of placer gold recovery has been practiced on the Guayape, and it may be that of late someone has been foolish enough to attempt the dredging method. Some years ago an outfit went up on the Guayape with a suction elevator which was guaranteed to bring gold up from the greatest depths. The apparatus was driven down through the gravel nearly 100 ft., some of the shallower parts of the canyon having been selected, and the process was begun. There was a doubting Thomas in the party, and when the golden grains failed to flow out of the discharge he quietly hiked himself to a near-by Indian village and bought some gold. Some of this was in small nuggets and all of it would be classed as coarse gold. Surreptitiously he dropped it into the apparatus, and when the power was turned on waited for its reappearance, but it simply went to join the other metal in the bottom of the canyon of the Guayape.

Another man discovered an auriferous bench, with a heavy overburden, on the Guayape. He had been in the country some time, and knew some of the tricks of the river, so he did not attempt to use its waters, but went up a side canyon where there was a stream which the natives said had never had a cloudburst. He spent \$25,000 in building a dam and ditch, but just as it was finished and the giant, brought in fourteen days from Trujillo on mule-back, set ready to begin sluicing, the stream had its first (?) cloudburst, and his little fortune was but a memory.

In one of the southern states of Mexico two Americans built a mile of ditch, a water-driven shaking grizzly, and elevators. Except the elevators, this was placed well above the torrential water line of the rainy season, but after about a week's work, showing magnificent results, a cloudburst came. The plant, other than the elevators, was not damaged, but when the waters subsided the bar had been shifted across and down the wide stream bed some hundreds of feet. On this same stream a small dredge was built and under similar circumstances to those just noted the barge was carried over a mile down-stream and smashed into kindling wood against a cliff which was normally about 200 ft. from the water.

Sluicing on tropical streams is impossible at most seasons and very uncertain at all seasons. This, of course, does not refer to the small outfits and short strings of boxes set up on some little feeder where the drainage area is small, but is applied to real mining where real results are hoped for.

The truth of these assertions will be at once realized and acknowledged by anyone who has attempted placering in the tropics, and by many it will be acknowledged with a host of bitter memories. However, there is a way in which these tropical placers, and those so located that they are under similar conditions, may be worked independently of high water, cloudbursts and interfering elements of like character, and it is not so sure but that any placer deposit can be more successfully and cheaply worked by this method than by boat dredge, regardless of pluvial conditions. This is by the dragline dredge method. This has the following to recommend it:

First, cost of installation, which is only a fraction of boat dredge costs under the most favorable conditions that a dredge can be constructed. This factor is still more markedly prominent when the site of the installation is remote from rail transportation and increases with the difficulties and distance of that transportation.

Second, first cost of the actual machinery and equipment involved; also the cost of operation.

Third, security of installation, as in all cases the actual plant may be located entirely out of the influence of sudden rises of the streams. The worst which can be done in such a case is the tearing out of the dead end, though the weight and strength of the track cable and the necessary security of the dead end renders this hardly probable.

Fourth, saving of sluice values, as these may also be located above torrential water and the operators saved the grief of seeing a line of boxes, well loaded, swept away and their contents scattered beyond recovery.

Fifth, indifference to shifting of gravel bars and refilling of stripped areas by floods. The former, in most cases, is merely a case of shifting the dead end and in the latter a redredging of the overburdened area.

Sixth, flexibility, where in the case of stream dredging, auriferous bench bars can be worked with no further changing of the plant than shifting the dead end. Under this is also included radius of action, which on the horizontal plane is confined only by the strength of construction and in the vertical plane has never been tested to a point of failure. Capacities may be as the operator wills, taking into consideration available capital and related conditions of transportation.

Many other points in favor of the dragline rig could be cited, but these indicate its superiority on the vital points.

It, of course, must be understood that the dragline outfit is not an apparatus for two- or three-foot gravel, as it is greedy and would clear a shallow gravel bar so quickly that practically all of the time would be spent in set-ups, which are costly. However, a modification of the larger plants herein referred to will work successfully in fairly shallow gravel, but the limiting factor in these is bucket weight, as toy outfits will not produce results.

The question of moving these plants from dredged-out areas naturally arises. This offers no particular difficulties, as it is rarely done. The wide radius which the properly constructed and located plant controls is such that removal to cover new ground is not often necessary, particularly in the case of deep gravels where the machine may work from the same site, with occasional shiftings of the dead end, for years in succession. When the gravels within the radius of the machine are actually exhausted there is nothing for it but a removal, which in most cases is the matter of stopping recovery and expending some thousands of dollars. This can generally be expedited by building a new tower and powerhouse and moving the machinery to it, salvaging the old one. The expense is comparatively small, considering all factors.

It is believed that the use of the dragline will assure successful operation of practically all of the placers in tropical countries which have heretofore been given up as hopeless on account of the water conditions referred to, as there is practically no place to which it is not applicable, except the shallow gravels, while the deeper gravels which the ordinary dredge cannot reach, anywhere, offer it no particular difficulties, other than those which it encounters within depths suitable to dredges of the larger capacities.

Smokeless Powder as a Blasting Agent

In a recent bulletin issued by the U. S. Bureau of Mines (*Reports of Investigations*, No. 2,386), C. E. Munroe and Spencer P. Howell discuss fully the use of smokeless powder as a blasting agent.

Smokeless powder has successfully replaced black gunpowder as a propellant in guns, and it may properly be asked why it cannot replace blasting powder in blasting rock. In reply it may be stated that before smokeless powder had been adopted by any nation as a military explosive the military requirements had led to the manufacture of black powder much too large in size for any practical use in blasting; this condition has obtained for the smokeless powder that has replaced the black gunpowder, so that whereas small-arm powders might be used to some extent, most of the powder cannot be so used because it was designed for larger caliber guns. Moreover, smokeless powder is more difficult to fire by ignition than black gunpowder; further, most blasting today is done by detonation instead of by ignition, and smokeless powder in grains cannot be efficiently detonated by the methods in use in blasting.

Major John Herbert Hunter, Ordnance Department, U. S. A., has discovered that when smokeless powder is ground sufficiently fine, the ground material can be detonated by means of a No. 6 or No. 8 detonator and therefore may, in this condition, be used as a blasting agent. He has been granted U. S. Letters Patent 1,382,287, of June 21, 1921, on a "Process of converting propellant powders into detonating explosives" to cover

this discovery. He has dedicated the patent to public use in the United States, wherefore all are free to use the process without payment of royalty. In his specifications Major Hunter points out that the rate of detonation of this comminuted smokeless powder varies with its fineness as measured by sieves of 8 to 80 mesh; it is possible, then, by regulating the grinding and sieving, to prepare explosives having different but determined rates of detonation, thus suitable for various kinds of blasting. He provides that in use this comminuted smokeless powder shall be packed in cartridges, as is the practice with dynamite. The product is styled *comminuted* because this term is broad enough to include any and every method of subdividing the grains without destroying their chemical identity.

GENERAL CHARACTERISTICS OF THE NEW BLASTING AGENT

Comminuted smokeless powder has a pale yellow color with an earthy luster. It is tasteless, odorless, and insoluble in water. When touched by the tongue it gives the sensation imparted by dry earth or chalk. Being insoluble and non-volatile it is not poisonous, and so far as this characteristic is concerned, it may be handled with impunity. It does not melt when heated, but it is very inflammable and easily ignited.

Tests showed that comminuted smokeless powder can be used for certain blasting purposes, especially in blasting stumps, boulders, and ditches. As the gaseous products of detonation include poisonous and inflammable carbon monoxide, comminuted smokeless powder is unsuitable for use as an explosive in dusty and gaseous coal mines or in other places where inflammable dust, gases, or vapors may be encountered. Nor should it be used in mines, tunnels, or other close places, unless the ventilation is very good and workmen are not in contact with the poisonous gases produced by it.

Comminuted smokeless powder is ignited easily and burns, but is detonated most effectively not by a fuse but by a No. 6 electric detonator. This powder proved to be sensitive both to percussion and friction; it is much less sensitive to percussion than 40 per cent straight dynamite, is more sensitive than dry picric acid, and about as sensitive as nitroglycerin and gelatin dynamites. As to propulsive capacity, comminuted smokeless powder rated highest of the explosives tested, except dry picric acid. The rate of detonation—which is the measure of its shattering power—was about 6 per cent lower than the 40 per cent straight nitroglycerin dynamite taken as a standard. The primary charge must be dry; an adequate quantity of stemming should be used in the bore holes, and should be well tamped. Comminuted smokeless powder is unsuitable for propagated blasting.

Conservation of Smelter Heat

In an old copy of a newspaper published in Clifton, Ariz., is found a brief description of the method used by a pioneer preacher to keep his congregation warm in chilly weather. His large tent was placed near the furnaces of the old Arizona Copper Co.'s plant. Of evenings, shortly before church time, he would wheel in four pots of glowing slag that speedily took all nip from the air and that maintained a grateful heat all through the service. It may well be recommended that this scheme be again worked in Western copper camps in the event of a serious coal shortage.

The Price of Radium in Relation to the Cost of Mining

Prospecting and Development Expense Greatly Increased—Despite Advantages of Core Drilling, Blind Tunneling Must Eventually Be Returned to in Search for New Deposits—Concentration a Difficult Problem

BY GEORGE KUNKLE

THE importance of the cost of mining radium ore, in relation to the present and future price of radium, will be readily appreciated when it is known that it constitutes practically 50 per cent of the total cost of production; and if adequate amortization charges were made against depletion, this percentage would be considerably higher, and it will continue to increase alarmingly as mining developments are extended.

Unfortunately the prices paid at first for carnotite, the principal radium-bearing ore, bore no true relation to the cost of production. The ore was mined promiscuously and intermittently under the uncertainty of commercial markets, and accumulated in many cases on the dumps as a result of assessment work, which was done to hold such ground in anticipation of a buyer at from \$100 to \$200 per claim. With no established markets almost any price was accepted by the small debt-ridden operator for these ores, and these prices ranged from \$1 to \$2 per lb. for the U_3O_8 contained in a 3-per cent ore, f.o.b. common shipping points, which, if we accept the highest figure, is equivalent to about \$17 per mg. of radium in the crude ore.

Furthermore, the mining costs resulting from the first systematic mining operations were also faulty and erroneous, as they were based upon favorable physical conditions that in the nature of things were bound to disappear rapidly and that were peculiar to the deposition of this ore. I have reference here to the first easy surface prospecting with the pick in locating outcrops of ore, and to the fossiliferous carnotite-bearing trees.

The remains of large shallow open pits and cuts bear eloquent testimony to this royal road to radium. Prospecting required no more elaborate equipment than a sharp pick and a good eye for "float" and outcrops. These superficial ore deposits were covered in many instances with but a few feet of earth, and mining was a relatively inexpensive and attractive pursuit. Under these unsettled and varying conditions the mining costs of radium ran from \$16 to \$17 per mg., f.o.b. Denver, and in one notable instance these figures were actually used and published in an article that purported to be an experimental study of the cost of production of radium.

However, in the course of a couple of years, following the impetus given the radium industry after the outbreak of the Great War, the supply of ore from these superficial pockets failed to satisfy the increasing demand. Prospecting for new lenses and pockets by tunneling and crosscutting became excessively expensive. The industry had clearly outgrown the gophering stage.

The jackhammer and core drill were then resorted to. Properties were carefully mapped, the survey showing the contour of the rim and the overburden, and systematic drilling was done on ground having an overburden not over 75 ft. deep. When once started, this work was enthusiastically taken up by other operators,

for by the use of the drill it is possible for an experienced operator to determine with fair accuracy the quality and extent of an orebody. It also enables him to attack it from the most advantageous point, and to block out his reserves somewhat in advance, thereby stabilizing operations, in addition to making a saving by avoiding the driving of tunnels in barren territory in the search for ore.

Ore developed by core drilling, however cheaper than that opened by blind tunneling, is far more expensive than the first pick-developed ore exposed by erosion; for it is probable, despite the fact that no authentic figures have ever been made public, that the average cost of developing 3-per cent U_3O_8 ore by core drilling is not less than \$60 per ton. To this must be added mining costs, including the cost of shaft sinking and of tunneling, besides that of transportation to the railroad, which will possibly bring the total ore costs up to at least \$200 per ton, f.o.b. common shipping points, or practically \$28 per mg. of radium against the early \$16 and \$17 per mg.; or an increase of nearly 65 per cent over the cost of the surface-developed ore.

The actual commercial producing areas within the geographical limits within which ore may possibly occur do not exceed 1 per cent of that territory. Under the stimulus of war prices for ore, this territory has been thoroughly prospected. The few new areas opened up during the interval were not very encouraging. Personally, I examined most of these new prospects.

However, let us grant that 10 per cent of all the territory within the ore's possible geographical limits will, with improved methods of prospecting, eventually become commercially productive. In that case, what percentage of this enlarged territory will be accessible to core-drill development? A good contour map of the region will undoubtedly show that not more than 0.5 of 1 per cent of this possible 10 per cent can be economically prospected with drills, for it is only in the small favored sections of the present 1 per cent that a drill is of any value at all, and territory of this kind is being rapidly exhausted, some operators having reached the point of maximum development, while others will reach that point in a short time. In other words this mining period may be characterized as that of the "flush production" of the radium industry up to the point of its present development in the United States.

The use of the drill also carries with it some warnings, as it has extended our knowledge of what not to expect in the future development of this ground. When the core drill first discredited the "rim rock" theory of the deposition of these ores, the pendulum, as usual, swung to the opposite extreme; but further experience with the drill soon disclosed the fact that it is possible to exhaust a claim rapidly, and to have extremely rich spots of ore on a claim and find the remainder of the ground practically barren. This does not augur well for the other 99 per cent of unproductive territory which is spotted similar to the areas already drilled.

Following the introduction of the drill, there was also introduced a new evaluation of property or claims, and according to the overburden they were spoken of as either "cliff" or "surface" claims. This classification, though convenient, is arbitrary, as some so-called cliff claims have small areas accessible to the drill, while some surface claims often have a considerable area inaccessible to the drill. The bearing of this upon our subject means that in time, and possibly sooner than the eastern offices of some operators imagine, all claims will eventually become cliff claims and in direct ratio as their drilling ground is being exhausted.

The man, therefore, who is looking to the future for cheaper radium, regardless of how treatment costs may be lowered during the interval, will certainly be disappointed, unless cheaper sources of this ore hitherto unknown are discovered. Viewing this subject wholly from the mining viewpoint, it is highly probable that radium has reached the lowest price level at which it can ever be profitably produced.

Notwithstanding popular notions regarding monopoly, the lot of the radium producer has been an unenviable one, and in the midst of this destructive policy he is squandering the flush production of his radium resources like a drunken sailor.

It is only a question of time when tunnel driving in search for ore will have to be resorted to permanently, and to make that profitable or even feasible the radium producer will become more and more a vanadium producer; the position of the byproducts will be reversed. He will further learn that the rich carnotite-producing properties of today will not be the properties he will seek tomorrow, as it is seldom that they afford any continuous production of vanadium along with the occasional carnotite.

Concentration, where tonnages justify, will be more extensively practised in the immediate future; but neither is this problem as simple as first supposed. Any method of concentration which overlooks the vanadium content of these low-grade ores must fail in the long run. These low-grade vanadium ores predominate in every locality where the combined tonnage accumulates in sufficient quantity to justify the building of a mill.

The low-grade carnotite ores offer few obstacles to successful concentration, as they are mechanical mixtures in which the uranium forms the cementing material between the grains of silica; but with the vanadium ores the case is entirely different. These vanadium ores associated with vanadiferous sandstones range in physical characteristics from true roscoelites or silicates to mechanical mixtures. The greater part of the tonnage of them, however, regardless of the locality in which they originate, is pseudo-silicates, the vanadium having penetrated the outer shell of the sand grain when the silica was in a semi-colloidal state. No amount of mechanical attrition will remove these partly chemically combined oxides in commercial, recoverable quantities, as is possible with low-grade carnotite. Furthermore, these mining areas are isolated from railroads, chemicals and fuel, so that the problem presents itself in such a way as to make its solution difficult.

In summing up the situation, cheaper radium cannot be expected from the mining viewpoint, unless new, and at present unknown, cheaper sources of this material are discovered in the future. Not only will it not become cheaper, but the tendency in price will inevitably be upwards.

Iron Ore in the Malay Peninsula

According to the annual report of J. B. Scrivenor, government geologist of the Federated Malay States, interest has been shown in the iron-ore deposits of the Malay Peninsula, following the exploitation of a deposit on the Batu Pahat River, Johore, by a Japanese company (Nanyo Kogyo Koshi). This deposit was visited by Mr. Scrivenor in January on behalf of the Johore Government. The workings are on Bukit Menia. The backbone of the hill is a lode of hematite, with a little other mineral matter. The slopes on either side are covered with debris from the lode, which is stated to be between 10 and 15 chains (1 chain = 66 ft.) broad and 40 chains long, but no walls were visible in January. Evidence was found of granite rocks in the neighborhood of the lode, a boulder at the foot of the hill and kaolin in a well. The ore is being exported to Japan.

A large hematite deposit occurs at the north end of Gunong Panjang, close to the high road from Ipoh to Tambun. This is on a rubber estate. Attention was drawn to its size by J. F. Newsom, of the Yukon Gold Co. W. E. Cameron reported that possibly about 2,000,000 tons of ore is available above surface drainage level and probably 4,500,000 additional within 100 ft. below that level. Analyses by J. C. Shenton of two samples of the ore collected by Mr. Cameron are as follows:

	First Sample, Per Cent	Second Sample, Per Cent
Iron.....	68.02	68.70
Sulphur.....	0.03	0.013
Phosphorus.....	0.07	0.086
Manganese.....	0.60	0.45
Ferric oxide.....	97.12	98.14
Insoluble matter.....	1.08	0.87
Phosphoric anhydride.....	0.17	0.197
Sulphuric anhydride.....	0.10	0.034
Manganous oxide.....	0.66	0.50
Lime.....	Trace	Trace
Magnesia.....	Trace	Trace
H ₂ O and loss on ignition.....	1.48	0.38
	100.61	100.121

Unfortunately this deposit is badly situated for transport. To work it on the spot would entail the destruction of a large area of jungle in the Main Range for charcoal even if electric furnaces were used for smelting.

Slate Mining Is Active

Shipments of roofing slate in July, 1922, were the greatest in several years, according to producers reporting to the National Slate Association. Many buildings and homes are being re-roofed which were roofed with temporary materials during the rush of war construction, when the production of slate was curtailed by the exodus of many workers into service. Slate, because of its natural beauty, durability, and fireproof characteristics, is receiving a large share of this business. The shipments of slate for roofing purposes, according to the reports from over 50 per cent of the producers, exceeded the June production by nearly 60 per cent, so that considerable inroads were made into the stock on hand as of July 1. Production in July showed considerable increase over that of June, and August promises even higher figures. Two of the largest slate mines of the country have been shut down for nearly three months on account of a strike. Even discounting the loss of this production, it is believed from the total figures of sales of slate for the first seven months of 1922, which averaged \$700,000 a month for natural slate, that this year will be one of the best the slate industry has experienced in the last decade.

CONSULTATION

New Uses for Selenium and Tellurium

"Am I correct in my understanding that some new uses have been discovered for the metals selenium and tellurium in automobile manufacture? How important are these uses?"

The new uses for selenium and tellurium which you mention probably refer to the employment of compounds of those two metals in the fuel for automobiles and not directly in their manufacture. As recently reported in *Engineering and Mining Journal-Press*, the laboratories of the General Motors Co., in Moraine City, Ohio, gave information to the effect that by the use of selenium oxychloride or di-ethyl telluride the efficiency of a given amount of gasoline could be doubled. The tellurium compound was the most efficient and especially advantageous in eliminating the knock which is developed when the motor is laboring on a grade.

Additional information is supplied by some remarks which appeared in the May, 1922, issue of the *Mining Magazine*, London, by W. E. Simpson, who stated that part of the experimental work of the General Motors and other automobile manufacturing companies was designed to improve the efficiency of the conversion of the freshly generated gas power into mechanical motion and to correct the lack of flexibility and elasticity of the explosive gases, characteristics favorably associated with the use of steam. The gas engine develops its power with explosive suddenness, whereas the steam engine has its power under complete control so that it can be applied continuously or expansively as may be preferred. It is that quality which experimenters have been anxious to impart to gas.

Midgley and Boyd, the chemists who devised the process using selenium and tellurium compounds, prefer the use of di-ethyl telluride, a highly volatile compound, which when added in the minutest quantities to gasoline for automobiles, serves to increase the running efficiency of the engine 100 per cent.

No explanation is offered regarding the precise influence of the compound on the gasoline, but it is believed that the action is catalytic. It seems to retard the intensity of the explosion in the cylinder so that the full force of it is felt after the cylinder has moved on its downward stroke. In describing a test which he witnessed, Mr. Simpson states that an automobile engine was run experimentally to a point which gave considerable back-firing and knocking. At this stage a rag was dipped into a solution of di-ethyl telluride and held just sufficiently near the air inlet as to permit the smallest amount of vapor to enter the cylinder. Instantly the knocking ceased and the engine functioned with a smoothness that was truly remarkable, while the quantity of gasoline consumed was reduced to one-half. The amount of telluride consumed was almost infinitesimal—one part to about ten thousand.

However, there is one serious objection to the use of this volatile telluride that will have to be overcome before it can be put to commercial use, and that is the

poisonous character of the exhaust gases of the engine using the telluride. Those readers who have experimented with selenium and tellurium compounds will recall the foul odors of some compounds of these metals. Another objection is the small amount of tellurium and selenium produced in the world. It has been estimated by Victor Lenher that if only one one-hundredth of 1 per cent should be used in gasoline the amount of tellurium required for the gasoline used at present in the United States would be 1,500 tons. Although the capacity of the United States at the present time to produce tellurium is about sixty tons per annum, this amount could be readily increased provided a demand for the product is insured. Tellurium and selenium have generally been unimportant byproducts of electrolytic copper refining for which a use has been urgently wanting. Further experimentation may overcome the objection to the noxious character of tellurium gases.

It has been suggested that aeroplane engines might use the substances as their operation would not diffuse the objectionable gases where they would be harmful to human beings.

At the present time selenium metal is quoted at \$1.80 to \$1.90 per lb., and tellurium metal \$2 per lb. A strong demand for both tellurium and selenium would greatly increase the price, and might make their use prohibitive.

Bauxite Has Variety of Uses

"Is bauxite used in appreciable amounts for purposes other than aluminum manufacture and refractories?"

Although bauxite is used chiefly in the production of aluminum, it has other important applications. The manufacture of aluminum salts consumes large quantities of the mineral. In 1921, according to the statistics of the U. S. Geological Survey, 91,700 tons of bauxite was used in aluminum manufacture, 41,000 in the chemical trades, 6,850 in abrasive manufactures and practically none in aluminum refractory production. Almost half as much bauxite was used in the chemical trades as in the production of the metal, a ratio that is much higher than normal. In 1917, 1918, 1919, and 1920 about five times as much aluminum was made as aluminum chemicals.

The principal chemicals derived from bauxite are, Alum (a double sulphate of potassium and aluminum), aluminum sulphate, alumina, and aluminum chloride. Aluminum sulphate is produced in two grades, the "commercial" and the iron-free. It is used in the softening of hard water. The use of bauxite in the manufacture of artificial abrasives is more important at the present time than the bauxite refractory trade. The decline in the use of bauxite for use in refractories is attributed to the competition of high-alumina clays, such as are found in central Missouri, and which are used satisfactorily as a substitute for bauxite. Diaspore has been used for the purpose. In fact, the U. S. Geological Survey estimates that 20,000 tons of high-alumina clays were used for refractories last year.

THE PETROLEUM INDUSTRY

Southwest Texas Oil Fields

Potential Production Invites Further Geological Research—Classification of Material Brought Up by Drills and More Perfect Log Records Essential to Sound Development—Natural-Gas Resources Important

BY W. T. OWEN

ALTHOUGH MANY GEOLOGISTS hold that beneath the Upper Cretaceous stratum the shallow fields of southwest Texas offer possibilities of finding oil in great quantities, particularly if the Pennsylvania structure be penetrated, tests in Bexar County in the past have penetrated no further than the Comanchean (Cretaceous) structure, and in but two of the eighteen wells—the only ones whose logs are available, though 144 so-called deep tests have been drilled—was oil encountered in sufficient quantity to be considered worthy of mention. Therefore, Bexar County being typical, whatever the future may hold in the way of deep development, this area primarily is a great basin of shallow oil, interspersed with natural-gas fields.

The Bexar County shallow field lies to the east, west, and south of San Antonio. No oil has been discovered on the north. There is a tradition that, many years ago, before the commercial value of oil was fully realized, farmers and ranchers endeavoring to find water pronounced the oil they invariably found to be a great nuisance. If this tradition be true, there may be oil also in the northern part of the area. The shallow oil of the Somerset, Mission, Alta Vista, and other fields of this county comes from the Upper Cretaceous or higher structures.

SOMERSET FIELD SUPPORTS THREE REFINERIES

Somerset, eighteen miles southwest of San Antonio, is a typical southwest Texas shallow field. The recognized sands from which production now is drawn are found at 900 and 1,200 ft. in the northeastern end of the field, but drop with the slope of the formation in the

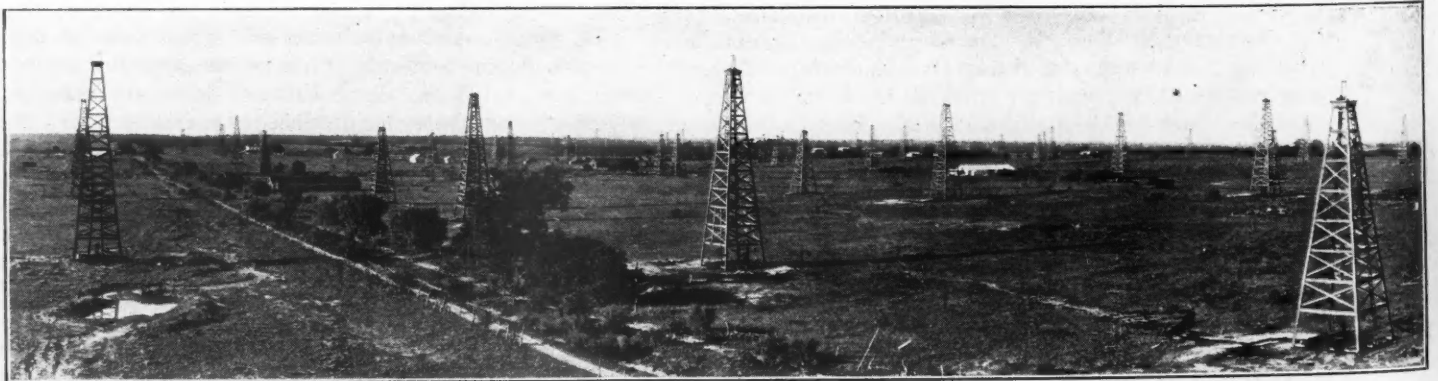
extreme southwestern extension to approximately 1,400 and 1,700 ft. The average well produces around 8 bbl. a day, but among the newer drillings, in which greater care than formerly was considered necessary has been exercised, there are many wells making from 20 to 40 bbl. daily.

The only "gusher" in the field was the Grayburg No. 4 Hartung B, which for a time had flush production of 300 bbl. a day, but now is producing approximately 40 bbl. daily on the pump. The same company's No. 5 Hartung B was completed during mid-August, and flowed by head, producing approximately 150 bbl. a day of clean oil. It was brought in at approximately 1,600 ft., and is the second best well in the field. The Texas Carruthers No. 4, of the Grayburg company, is pumping 35 bbl. a day. These three are the best wells ever completed in the field.

Somerset oil has a paraffine base, and a specific gravity of 28 to 43 deg. Bé., only a few wells showing the latter type of oil, that of the lower gravity predominating. Gasoline content varies from 20 to 28 per cent. A noteworthy feature of the field's development is that production both north and south of the recognized center of the oil-bearing area has been found to be somewhat larger than in the central field.

Three refineries, two at Somerset and the third at San Antonio, furnish the needed outlet close at hand for the field's production.

The field is little more than 10 per cent developed, but it is anticipated that with betterment in conditions surrounding the oil industry its productivity will increase enormously. During the months of July, August and



Panorama of the Somerset shallow

September, 1921, 158,000 bbl. of oil was produced in this field. This equals about one-half of the production of the state of Texas for one week at the period noted. During the year 1920 the number of wells in the field was doubled, and similar activity would have marked 1921 but for the drop in the price of crude. However, a number of strong operators are in this and adjacent fields, carrying on a steady program of drilling. This is resulting not only in additional producers in the proven field almost every week, but in extending the known oil-bearing zone. Drilling is relatively inexpensive, and, as far as the field has been outlined, is attended by comparatively little risk. Production on the beam varies from 5 to 100 bbl. a day.

On the Manuel Yturri tract, south of San Antonio and near Mitchell Lake, ten wells early this year were pumping a total of about 100 bbl. a day, the oil being obtained at remarkably shallow depth. On Gas Ridge, the San Antonio Oil & Natural Gas Co. has opened a field where wells approximately 500 ft. deep are producing about 4 bbl. each daily. This oil is being marketed by truck in San Antonio. At the south end of Gas Ridge, Hanson Bragg has opened another field, where, at 550 ft. he obtains an average of from 3 to 4 bbl. from each well daily.

Eight miles east of San Antonio the Azalea Oil Co. has been drilling a deep test on the Thormeyer farm. Two paying strata of shallow oil were encountered as the drill went down, one at 468 and the other at 753 ft. Neither of these has been developed, so that production is merely problematical.

Beginning at the Rio Grande, there is a chain of shallow oil fields extending northward into Wilson and Bexar counties, a distance of fully 250 miles. The Zapata Producing & Refining Co., of Zapata County, near the Rio Grande, has a group of shallow wells that from a depth of about 160 ft. are producing at the rate of about 2 bbl. a day. Next in a northerly direction lies the Mirando field, in the northeast corner of Zapata County. Activity in that area has increased enormously since oil first was discovered in 1921, and in Zapata and Webb counties the chief interest is centered at this time.

MIRANDO VALLEY WELLS AVERAGE 50 TO 200 BBL.

The Mirando Valley field, in which the discovery well of the Mirando Oil Co. is situated, is approximately thirteen and one-half miles south of the Texas Mexican Ry., in the northeast corner of Zapata County, and the Webb County or Schott field really is a continuation of the same formation. The area under development is

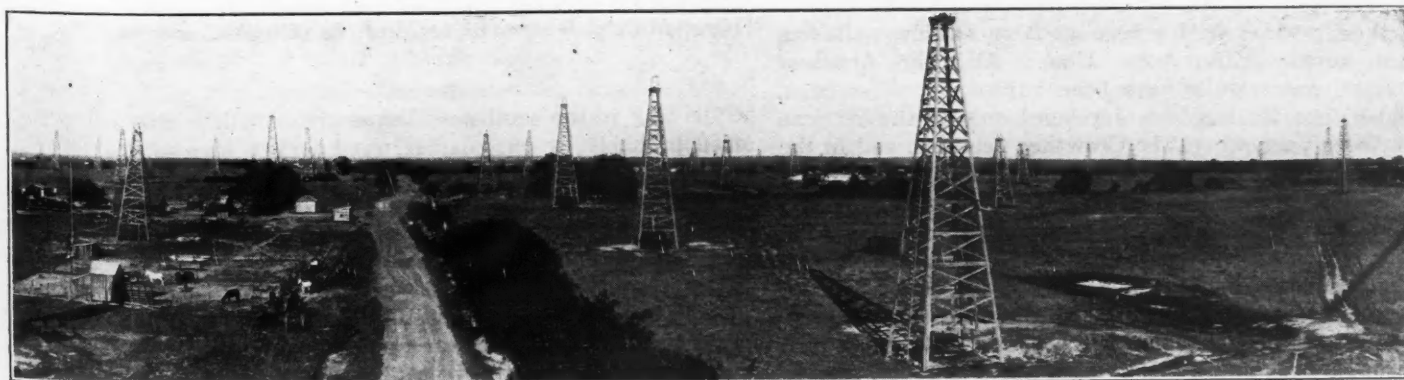
approximately twenty-five miles long. The original Mirando well was brought in at 1,450 ft. with an average production of 100 bbl. daily. The average well in the Mirando Valley field produces from 50 bbl. up to 200; in the Schott field heavy production is promised.

The Mirando and Schott field oil apparently had little gasoline content. It is the confident claim at the field that ultimately Mirando oil will with slight refining take its place with the Pennsylvania natural lubricants and become an active competitor in the market.

The Carolina-Texas group, the pioneer wells of the Webb County field, have opened the way for what promises to be heavy production. In the Schott field, at approximately 1,565 ft., the Kan-Oka No. 1 came in the latter part of April with estimated production of 175 bbl. daily. During the latter part of June the well was swabbed, and resultant production mounted to between 1,500 and 2,000 bbl., despite the fact that the bailer had become wedged in the liner at the bottom of the hole. Early in August the bailer and liner were brought nearly to the surface, with the result that production increased. An actual test is reported to have shown the flow to be 125 bbl. an hour, or 3,000 bbl. daily. Kan-Oka No. 2 is drilling, and a rush has been made for the field. It is generally believed that if the bailer were removed a material increase in production would be obtained. In this field also is situated what is declared to be the largest gasser in the world. Carolina-Texas No. 3, cased with 6-in. pipe, came in July 30 with 64,000,000 ft. of gas in a day. Carolina-Texas No. 2, another great gasser, sold several months ago to the Texas Co., is now showing some oil. It is in this field, if anywhere in the southwest Texas area, that gusher production may be anticipated.

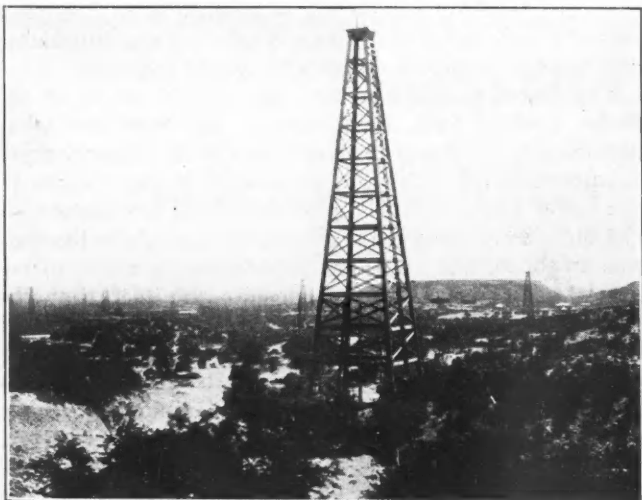
DEEP DRILLING IN DUVAL COUNTY

To the east of Webb County lies Duval County, where there are shallow fields at Piedras Pintas and Noleda, which have been producing shallow oil for years. In this county also a number of large oil companies are drilling deep tests. The Humble Oil & Refining Co., operating in the south-central part of the county, at last report was setting casing at 3,068 ft., preparatory to cementing and making a test of the sand on which the drill rests. This well is in the Coastal Salt Dome portion of the county, and is the second well drilled by Humble. The first was capped after reaching 4,023 ft. The first hole is a mile southeast of No. 2. Considerable activity in leases has been in evidence recently, prices paid by large operators ranging from \$60 to \$300, the land either being pur-



oil field, near San Antonio, Texas.

chased outright or with seven-eighths oil rights. In the north-central part of Duval County, fourteen miles northwest of San Diego, Mar-Tex Oil Co. is putting down its fourth deep test. Gray Ridge is on its first deep test at 3,896 ft., at last report, and was setting casing, preparatory to cementing for a test.



Mirando valley field.

The National company, just east of the Humble No. 2, is reported to be drilling around 3,000 ft. and showing up the same sand which was found in National's No. 3 well, which was lost before a test could be made. The National Oil Co. is reported to have contracted recently to drill two additional holes beside its No. 4, on which work now is under way.

The Federal Oil Co. is drilling in the western part of Duval County on the Smith and Corkill ranch, and at last report was down 500 ft. It is following the structure that comes into Duval from Webb County and the Mirando Valley field. The Humble, National, Sun, and other large companies have purchased large tracts or secured leases on them, and the Texas Co. has purchased 28,000 acres of the Smith and Corkill ranch mineral rights.

MCMULLEN GAS FIELDS EXTENSIVE

Next to the north lies McMullen County, where shallow oil wells have been developed at about 1,000 ft. on the Lowe ranch. In northern McMullen are extensive gas fields. In Live Oak County there also is a large gas field, east of Three Rivers, with evidence of oil, both shallow and deep, though the field still is mostly undeveloped. In the southern part of Atascosa County is the Crowther field, where oil from shallow wells has been produced for some time. All over Atascosa County water wells have been ruined by oil seepage, which thus far has been developed only in the extreme southern part, where the Crowther field lies, and in the extreme north, where the Somerset field extends into Atascosa County.

East of Bexar County, oil is being marketed from the Wilson County shallow field at Floresville. Though oil was produced from one well and sold for several years, real development of the field started only late in 1921. The same line of shallow oil fields extends northward through the Thrall field, in Eastrop County, thence through the Mexia gusher field and on to the Corsicana shallow field. There is also a line of shallow oil fields

extending westward to Del Rio. Near Del Rio there were on Jan. 1, 1922, five shallow wells, with oil occurring at from 16 to 20 ft., that produced an average of 1 bbl. of oil per well each day. In the southern part of both Medina and Uvalde counties, shallow oil has been developed only in a limited way during the last few years, but sufficiently to prove its presence in that area, also.

Natural gas occurs in southwest Texas in great abundance, according to popular belief. Three Rivers, nearest field to San Antonio, has more than 200,000,000 cu.ft. of natural gas developed, awaiting arrangements for piping it to San Antonio. According to a local estimate, gas wells completed and, for the most part, unused had a potential daily capacity of 359,000,000 cu.ft. To this may be added the great Carolina Texas well and other gassers in the Schott field, recently brought in, bringing the total to approximately 450,000,000 cu.ft. At present, Laredo, in Zapata County; Kingsville, in Kleberg County; and Taft, in San Patricio County, are the only towns supplied from this reserve.

Named in their chronological order, the gas fields of southwest Texas are Reiser, Gas Ridge, Jennings, White Point, Three Rivers, Goliad, Kingsville, Refugio, Gray Ridge, Woodville, Oakville, Mirando, and Barnsley, having wells producing individually from 2,000,000 to 64,000,000 cu.ft. a day.

PROSPECTING AND GEOLOGICAL DATA

Scouts for large oil companies are said to have more than 100 deep tests on their lists, drilling in various parts of the area described, each being put down by companies financially able to guarantee completion of any program undertaken. Practically every county in the southwest district has at least one test well and some counties have several deep test wells going down.



Mirando City, mushroom child of the oil boom, growing rapidly.

Drilling in the southwest Texas area could be cheapened probably by one-quarter were perfect logs of the wells drilled maintained and the material brought up from the depths properly classified by geologists. Sand, shale, gumbo, and rock are about the only terms in the vocabulary of most drillers. A dry hole, with a thoroughly identified log, may be worth many times its cost in the development and discovery of the real field.

In connection with Bexar County's geology, F. J. S. Sur, geologist, recently wrote:

"In discussing the possibilities of finding deep oil in Bexar County, it is necessary to mention the formations

as they exist upon the surface and those that are known as greater depth is attained. Data are available, and hundreds of tests in the upper formations have proved the thickness of the Eocene and Cretaceous rocks. Seventeen tests have shown the approximate thickness of the Comanchean measures.

"The youngest rocks in the county are of the Quaternary age and they do not contain oil. Rocks of this age are divided as follows: (a) The Queen City-Carrizo formation, which is represented by sand at the surface in the southern part of the county; (b) the Wilcox formation, that is at the surface in the Somerset field and extends northward as far as the Alta Vista fields; and (c) the Midway formation, which is the oldest Eocene rock and rests on the Upper Cretaceous. The approximate thickness of this series is as follows: Queen City Carrizo, 200 ft. more or less; the Wilcox, 700 ft., and the Midway probably not more than 250 ft.

"Immediately below the Eocene are the rocks of an older age, the Upper Cretaceous. The highest formation of this age is known as the Navarro and is successively underlain by the Taylor marls, the Austin chalk, and the Nagle Ford shales. The total thickness of all of these probably does not exceed 1,300 ft.

"Below the Upper Cretaceous is a series of limestones, shales, and a few sandstones known as the lower, or Comanchean Cretaceous. The Buda limestone is the highest and youngest member of this group. It is underlain successively by the Del Rio clays (mudhole), the Georgetown-Edwards limestones, the Glenrose and the Travis Peak. The exact thickness of this series is unknown. It has been definitely penetrated by two wells in this county, each of which showed a different thickness. A third well on the Waring estate showed it to be at least 2,300 to 2,500 ft. thick.

"It is necessary to say that if a deep well were drilled on the south lines of the county, the bit would pass through the Eocene, the Upper Cretaceous, and the Comanchean. The depth at which the drill would pass through the Comanchean and into older rocks is problematical, but would be equal to the combined thickness of the above-mentioned strata—about 4,800 ft. At Somerset the depth would be about 4,400 ft., at Alta Vista, about 3,500 ft., and just west of San Antonio, as has been shown by the Waring well, not less than 2,700 ft.

"As far as structural geology is concerned, the county is easily divided into three zones: (a) That part north of the Balcones fault occupying the northern part of the county; (b) the Balcones fault area, and (c) that part of the county south of the faulted area. In zones (a) and (c), with the exception of local reverse dips and small faults, the strata dip toward the south and southeast.

"The oil found in Somerset, Medina, Alta Vista, and other fields in the county comes from the Upper Cretaceous or higher formations. Deep production would mean oil that comes from the Comanchean and older sediments. . . .

"From the fact that a large number of wells have been drilled into the Comanchean in Bexar County, as well as in other portions of the state, without enough oil being found to justify more than the shallowest of drilling, and because nowhere does the Comanchean show more than a trace of oil in its outcrops in this portion of the county, we are forced to the conclusion that rocks



Casing and supplies arriving in Somerset for use in surrounding field.

of this age promise little for the driller who plans to finish his well in them. It is highly improbable that oil will be found in them in paying quantities. Accepting this conclusion, not as final but as highly probable, it is to the rocks older than the Comanchean that we must look for deep production. To say that oil would be found in this series would be only a supposition. However, it is nothing new to say that it is quite possible to find the Pennsylvanian below Bexar County, and in it find sands capable of producing big wells. A number of very good geologists have held this belief for several years."

THOROUGH DRILL TESTING ADVISABLE

Continuing to exploit his theory of deep, underlying strata which may bear oil in quantity, Dr. Sur expresses the belief that in future the operators of this county should not bind themselves to contracts that call for a certain depth in feet, but rather should they plan "either to stop in the Upper Cretaceous or be amply prepared to go through the Comanchean and a considerable depth into whatever is below, if oil is not found in paying quantity at a less depth."

Discussing the deeper strata of this area, a paper issued recently by the U. S. Geological Survey, gave an interesting view upon that area tributary to the Rio Grande based upon data secured by L. W. Stephenson, of the Survey. It said in part:

"Most oil men now freely admit that the first prospecting for oil in any region should be confined to the anticlines, providing that they can be discovered, but in the plains of the Rio Grande, anticlines are not easily found, and the difficulty of finding them has doubtless been the cause of the failure of a large part of the prospecting. They are known to exist, however, and they can be found by a trained geologist. An anticline was discovered in the vicinity of Del Rio, Val Verde County, in the summer of 1921, by L. W. Stephenson, of the U. S. Geological Survey, who gives the following brief description of the geologic conditions in that region:

"With the exception of certain very recent deposits of gravel and loam which cover parts of the surface, the rocks exposed in the southeastern part of Val Verde County and the southwestern part of Kinney County are of the Cretaceous age and belong to the following geological formations, named in the order of their age from the oldest to the youngest: Edwards limestone,

Georgetown limestone, Del Rio clay, Buda limestone, Eagle Ford formation (shale and limestone), and Austin chalk.

"The normal dip of the rocks in the vicinity of Del Rio is toward the east and southeast. The Edwards limestone outcrops in the walls of the Devils River Gorge, ten miles northwest of Del Rio. The Edwards is overlain by the Georgetown limestone, which outcrops in much of the area between Devils River and San Felipe Creek, east of Del Rio. The Georgetown is overlain by the Del Rio clay, which outcrops in the steep westward-facing scarp of the valley of the San Felipe Creek east of Del Rio. The Del Rio clay is overlain by the Buda limestone, which outcrops in the upland southeast of Del Rio; the Buda is overlain by the Eagle Ford formation, which outcrops still further to the east and southeast, and the Eagle Ford is overlain by the Austin chalk, which appears at the surface in a broad area in the southeastern part of Kinney County.

"The existence of the anticline is shown by the abnormal extension toward the east of three formations: the Del Rio clay, the Buda limestone, and the Eagle Ford formation."

FURTHER GEOLOGICAL DATA NEEDED

Following discussion of tests which have shown the thickness of the Comanchean in this region to be 2,235 ft., the writer argues that the anticline is probably a reflection of the structure in the Pennsylvania beds, believed to lie at a depth of from 2,100 to 2,700 ft. In conclusion, discussing the desirability of drilling to depth, he declares:

"The justification for drilling a test well on an anticline fold depends in a large measure upon its size and character, compared with other folds in the same region. Folds that are eagerly drilled in the Mid-Continent region might not be thought worth considering if they were in Wyoming, where all the great pools have been found in steep-sided anticlines, and they would become even less promising in California. On the other hand, any anticlinal fold, however slight, in a region where the beds lie flat, may be promising, and this particular fold, which is more evident and apparent than any other known fold in this general region, undoubtedly merits a test if there is a reasonable chance that reservoir beds and oil-forming beds underlie it within a depth that can be drilled."

In but two instances has the Pennsylvanian structure been penetrated, as far as is known, in the area dealt with by the two geological reports quoted.

The Gas Ridge Syndicate, composed of Pittsburgh, Pa., capitalists, a few weeks ago abandoned a dry hole at depth of 3,800 ft. plus, and pulled casing, in the Gas Ridge field of Bexar County. The formation in the bottom of this hole was identified by J. A. Udden, of the State Department of Economic Geology, as Pennsylvanian or older. Of particular interest in this connection was the fact that the Gas Ridge Syndicate well started in the Austin chalk formation, which at this point crops out on the surface, although at Somerset it lies 1,400 ft. below the surface. Thus the Gas Ridge Syndicate well in reality was much deeper than its actual footage would indicate.

Accurate data are lacking upon the second well, which is said to have entered the Pennsylvania structure in the vicinity of Del Rio, although it is said that oil was discovered in no considerable quantity.

Crude-Oil Output Shows Increase

According to estimates of the American Petroleum Institute, the daily average gross production of crude oil in the United States for the week ended Aug. 26 was 1,499,850 bbl. as compared with 1,492,450 for the preceding week, an increase of 7,400. Following are estimates (in bbl.) of the daily average gross production for the weeks ended Aug. 26, Aug. 19, 1922, and Aug. 27, 1921:

	1922		Difference	1921 Aug. 27
	Aug. 26	Aug. 19		
Oklahoma.....	399,800	400,500	Dec. 700	310,230
Kansas.....	86,500	86,800	Dec. 300	98,200
North Texas.....	49,850	49,850		68,450
Central Texas.....	146,100	144,100	Inc. 2,000	107,720
North Louisiana and Arkansas	124,800	123,550	Inc. 1,250	126,300
Gulf Coast.....	113,700	108,800	Inc. 4,900	102,700
Eastern.....	122,000	121,500	Inc. 500	115,000
Wyoming and Montana.....	82,100	82,350	Dec. 250	43,970
California.....	375,000	375,000		330,500
Totals.....	1,499,850	1,492,450	Inc. 7,400	1,303,070

In Oklahoma the production of the Osage Nation is shown as 110,250 bbl. against 112,150; and the output of the Lyons-Quinn pool was 17,700, against 16,600 bbl. The Mexia pool, in Central Texas, is reported at 62,500 bbl., against 62,800; Haynesville, Northern Louisiana, 56,850, against 55,450, and El Dorado, Ark., 29,850, against 29,650. In the Gulf Coast field, West Columbia is reported at 32,500 bbl., against 32,250, and Orange County 16,000, against 16,700.

Texas the Scene of Interesting New Developments

Recent developments in Texas have been of great interest. The most important discovery is that of the Kosse field, Limestone County, where the Humphreys-Jones well, of the Humphreys interests, was brought in Aug. 17 making 5,000 bbl. of oil from 3,700 ft. This well is 25 miles south of the nearest production in the Mexia field. A new boom, similar to that of Mexia, is now on.

A new field near Eastland, it is believed, has been opened by the Hough well of the Car-De-Zone Oil Co., making 100 bbl. of oil and much gas from 3,550 ft. The well is four miles southwest of Eastland and two and one-half miles from the nearest production.

In the Laredo district, fifty rigs are drilling along thirty miles of escarpment. The Border Gas Co. will build a pipe line to the big gas well of the Carolina-Texas Co. on the Barnsley Ranch. This gas company now supplies Laredo with gas from the Jennings field. The Texas-Mexican refinery at Laredo, which will have a capacity of 1,000 bbl. daily, is nearing completion.

The Somerset field, south of San Antonio, in Bexar County, has been extended one mile west by recent drilling.

Salt water has appeared in the Pioneer field of Eastland County. The deep east and west areas are the most seriously affected, and the production of the field has fallen to less than 9,000 bbl. daily.

In the Coastal fields, big wells have been completed recently in the Hull, Orange and West Columbia dome areas. An important development at Humble is the extension of the field one-half mile to the southwest by the completion of two wells at 2,100 ft. in the Humble townsite. An oil showing is reported in the deep test of the Sun Company at High Island, Galveston County. A more extensive drilling campaign is expected on this salt dome soon.

New Books

Improving the Health of Employees

Health Service in Industry. By W. Irving Clark. The Macmillan Co., New York. \$2.

Those managers and superintendents whose experience has been varied will admit that, whereas unusual facilities exist for the efficient control of mechanical apparatus, it is seldom that systematic preventive and remedial measures are in vogue to insure the efficient working of the human machine. A few of the more influential mining companies are able, by reason of extensive operations and large labor forces, to take steps to ameliorate conditions arising from ill health, to maintain an adequate medical staff, and to provide proper surgical facilities for those in their employ. The need for such provisions in the mining industry is emphasized because of the isolation of operations in so many instances, and the danger arising in consequence of a lack of skilled attention. During recent years more and more attention has been paid to the scientific care of the health of industrial workers, the failure in the past having arisen, to a large extent, because physical disability was realized only when it was obvious to the untrained eye. The result was that a large number of cases of illness, which could have been checked easily if detected in the early stages, developed into maladies that terminated fatally or caused the patient many years of unnecessary suffering.

The book under review, written by the service director of a large industrial concern in Massachusetts, who is also lecturer on health administration in industry at the Harvard Medical School, is designed to give to those having no actual experience in the subject a short workable plan for a health department in an industrial organization. The author presupposes that the reader is a doctor or a superintendent, the result being that the text should be clear to either; indeed, most of it is couched in non-technical language—a fact that will be appreciated by the average mining engineer.

After a preliminary chapter on generalizations, the author discusses the medical needs of a small community and the equipment required. In the next chapter, emphasis is placed on the proper functions of a health department, with particular reference to (1) the physical examination of all applicants for positions; (2) the re-examination of all employees transferred from one department to another; (3) the periodic examination of those employed in work involving a menace to health (I discard the term "health hazard"); (4) the periodic examination of workers with physical defects that need attention; (5) the placing of physically defective workmen at non-injurious oc-

cupations; (6) the diagnosis and, when necessary, the treatment of those applying to the dispensary for medical care.

Such control of physical condition on the part of the employer may seem to be in the nature of an interference with the so-called right of every employee to do as he pleases; but times are changing, and it is being recognized that the maintenance of a high standard of health among manual workers is essential to the success of industry.

In subsequent chapters the author discusses dispensaries, the industrial physician and the industrial nurse, and the physical examination. Concluding sections of the book deal with the subjects of accidents and their treatment, sickness, sanitation, and special problems.

To those who have the planning of medical and sanitation work in a mining camp or small town, as well as to those who are responsible for the health and efficiency of workmen under their control, the volume will be found to contain much that is essential to the successful outcome of technical and industrial endeavor. A. W. ALLEN.

Material Handling Cyclopedia. By Roy V. Wright and others. New York: Simmons-Boardman Publishing Co. Illustrated, 847 pp. Price, cloth, \$10.

This treatise has been prepared to supply a need for definitions, descriptions, illustrations, applications, and methods of operating the devices and equipment used for what is commonly known as the handling of material. It is divided into three main sections: the definition section, the illustrated-text section, and the catalog section. The first has been subdivided into (1) general definitions and (2) electrical definitions. The illustrated-text section deals with hoisting machinery, conveyors and elevators, trackless transportation, and industrial rail transportation. The catalog section contains detailed information of specific devices, and is designed to supplement the information given elsewhere and to assist the reader in the selection of the proper equipment.

The efficiency of mining and metallurgical operations depends to a large extent on the economical handling of large amounts of crude ore and semi-finished and finished products. The volume in question is what it purports to be—a cyclopedia on the subject, which will be of value as a reference book.

Personnel Records—The University of Chicago Press, Chicago, has issued a 128-page book of representative record and report forms designed to give the personnel managers of industries ideas which will help them to determine policies wisely and administer them effectively. It includes blank forms for the employment section, for the training section, for the health and safety section, for the research and planning section, for profit sharing, insurance, and benefit work, and statistical forms for managerial use. Copies of the handbook may be obtained from the publishers for \$1.75.

Technical Papers

Mine Surveying—The *March Bulletin* of the Institution of Mining and Metallurgy, Cleveland House, 225, City Road, London, E. C. 1, contains an eighteen-page paper on "Methods of Measuring Horizontal Angles Involving Steep or Precipitous Sighting." Separates of the paper may be obtained for 1s. each.

Determination of Aluminum—"The Determination of Aluminum by the Phosphate Method" is discussed by J. E. Clennell in the May issue of the *Mining Magazine* (Salisbury House, London Wall, London, E. C. 2; price 1s. 6d.) Details of the best procedure are outlined.

Fire Extinguishers—"Tests of Hand Extinguishers on Zinc-Dust Fires" is the title of U. S. Bureau of Mines *Reports of Investigations* No. 2,335, obtainable gratis. Foamite Firefoam was found to be satisfactory for the purpose, and the best extinguisher tried.

Precious Stones—Bulletin 118 of the U. S. National Museum is a handbook and descriptive catalogue of the collections of gems and precious stones in the U. S. National Museum. It is a book of 225 pages and may be obtained from the Superintendent of Documents, Washington, D. C., for 50c. Besides being a descriptive catalog of precious stones, close to a hundred pages are devoted to the cutting of gem stones, gems mentioned in the Bible, mystical properties of gems and birthstones, gem and mineral names, industrial uses of precious stones, tables for the identification of precious stones, statistics of production, and a selected bibliography. In short, the book is exceedingly interesting and would be a worth-while addition to any library, technical or otherwise.

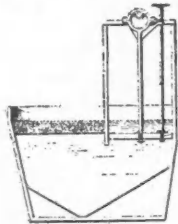
Philippine Mineral Resources—"The Mineral Resources of the Philippine Islands for the Years 1919 and 1920," a seventy-page bulletin issued by the Bureau of Science, Manila, P. I., has recently been received. Convenience of inspection would be enhanced had the pages been cut. The status and development of mining in the islands during the two years covered are given in some detail, and there is a special article on iron smelting. The principal Philippine mineral products, in the order of their money value production, are: gold, salt, stone, coal, sand and gravel, and lime.

Fumes From Explosives—All of the available information heretofore published on mine gases and fumes from blasting has been gathered and condensed into a forty-three page mimeographed article, "Fumes Encountered in Mining Operations and Handling of Explosives," by J. Barab. Free copies will be sent so long as the supply lasts, on application to the Hercules Powder Co., Wilmington, Del.

Recent Patents

Metallurgy of Vanadium—No. 1,415,028. Alphonse Gildemeister, Paris, France. Vanadium ores containing V_2O_5 are exposed to the action of dry chlorine in the presence of a reducing agent, at a temperature above the boiling point of vanadyl trichloride, but not above 400 deg. C. The vanadyl chloride distills alone and is subsequently collected.

Electrolytic Slime Treatment—No. 1,415,526. Masumi Chikashige and Denzo Uno, Kyoto, Japan. Electrolytic slimes are fused with a collector of the precious metals and an alkali-metal flux, and the non-metallic elements of the sulphur group and the precious metals are recovered from the fusion products.



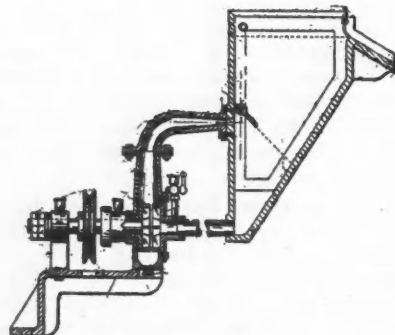
Jig—No. 1,415,428. John R. Combs, Tipton Ford, Mo. A jig for concentrating ores, of the type shown in the accompanying illustration.

Electromagnetic Concentrator—W. C. Hall, Butte, Mont. Ground ore is passed through an intensified magnetic flux established between the pole of an electro-magnet and a movable magnetic conductive member. Molecular currents flowing in one direction are thereby produced in the mineral particles, and the particles adhere to the movable member.

Slag Cleaning—No. 1,416,262. P. P. Butler and H. H. Stout, Douglas, Ariz., assignors of fifty-five one-hundredths to Phelps Dodge Corporation. Copper-bearing slag is fused with an ore suitable for washing out the contained copper, in a reverberatory furnace at a superheated degree of temperature.

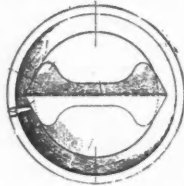
Zinc Ore Briquet—No. 1,415,094. D. B. Jones, Chicago. A briquet composed of zinc ore, a reducing agent, and a binder of bauxite.

Flotation Machine—No. 1,415,314. H. C. Colburn and E. A. Colburn, Den-



ver, Col., assignors to the Colburn Flotation & Engineering Co., Denver. A flotation machine of the design shown in the illustration.

Fume Precipitation—No. 1,413,993. S. H. Rhodes, Riverside, Cal., assignor to International Precipitation Co., Los Angeles. Suspended particles are separated from gases by distributing carbon smoke into the gases and then subjecting the gases to the action of an electrical field in such a manner as to precipitate the smoke together with the other suspended material.

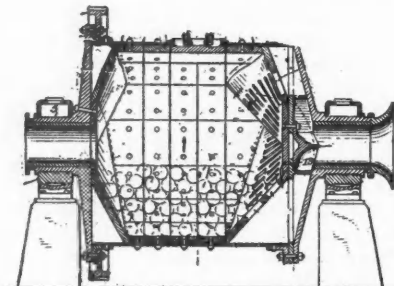


Gold Pan—No. 1,419,405. E. O. C. Ord, Berkeley, Cal. A miner's gold pan with a rib across the bottom as shown in the illustration.

Granulating Slag—No. 1,416,069. Wilhelm Schumacher, Osnabruck, Germany. The patent covers a method of obtaining dry granulated slag. As the slag comes from the furnace, sufficient water is discharged into the launder to granulate it. The water and granulated slag flow from the launder on to a short conveyor through which the water falls, the granulated slag being still sufficiently hot to vaporize any remaining absorbed water, so that the slag, as discharged by the conveyor, is dry.

Flotation Reagent—No. 1,412,215. D. W. Patterson, Douglaston, N. Y., and H. L. Woolfenden, Denver. The agent proposed is a small amount of the gummy frothing agent contained in "black liquor."

Ball Mill—No. 1,413,644. F. O. Williamson, Chicago. A ball mill with wedge-shaped discharge plates in-



creasing in extent, both radially and axially relative to the barrel, in a direction opposite to the direction of rotation of the mill.

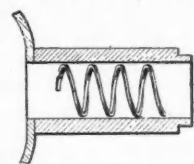
Potash and Borax Extraction—Nos. 1,415,203-4-5. E. P. Stevenson, Cambridge, Mass., assignor to General Bond & Share Co., Boston. Potash and borax are separated from Searles Lake brine by chilling, with various subsequent treatments. In Patent No. 1,415,206, the brine is treated with carbon dioxide to precipitate sodium bicarbonate, which is filtered off and subsequently decomposed.

Recovery of Sulphur Gases—No. 1,412,452. M. F. Coolbaugh, Golden, Col. Gases containing sulphur compounds are passed over a metal oxide at a temperature sufficiently high to form a sulphate. The sulphate is then heated to a sufficient temperature to liberate sulphur dioxide and trioxide.

Crushing Matte—No. 1,413,116. J. H. Hickey, Bozeman, Mont. Liquid matte is granulated by blowing air against a descending stream of the matte, the particles then immediately passing to the crushing machine for further disintegration.

Lead-Zinc Ore Treatment—No. 1,415,796. Niels C. Christensen, Salt Lake City, Utah. The ground lead-zinc sulphide ore is treated with hot concentrated sulphuric acid, which dissolves the zinc as sulphate. The solution is separated, and cooled, which precipitates the zinc sulphate. The residue is treated with a hot concentrated chloride solution containing acid, which dissolves the lead and silver as chlorides. The solution is separated and the silver and lead are precipitated. Patent No. 1,415,797 covers a part of the same process as applied to straight zinc ores.

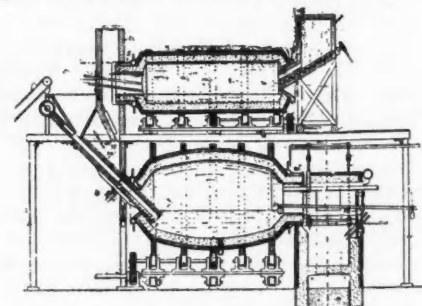
Ball-Mill Trunnion—No. 1,412,390. C. A. Duncan and Alfred Nelson, Wallace, Idaho. The discharge trunnion of a ball mill is fitted with a helical spiral suspended so that there is the desired amount of space left between the outer rim of the helix and the inner periphery of the trunnion.



Lead Ore Reduction—Canadian patent No. 222,077. G. F. Greenwood, Georgeville, Quebec, Canada. A process of reducing lead sulphide ores to the metal. The ore is first roasted by drawing air through a layer of the ore, or by other means, and then the lead oxide is reduced to the metallic state by treatment with carbon and heat in the absence of air. The carbon monoxide thus formed is burned to supply heat for the reducing operation. Patent No. 222,078 covers the application of substantially the same idea to other ores.

Mine-Skip Loader—No. 1,415,181. C. L. Lawton, Hancock, Mich. The patent covers mechanism to tilt a skip upward for loading from a chute, by means of a pair of auxiliary rails which engage the upper wheels of the skip.

Tuyère for Coal Firing—No. 1,415,910. R. A. Wagstaff, Salt Lake City, Utah, assignor to American Smelting & Refining Co., New York. A design of tuyère and cap for the introduction of pulverized coal into blast furnaces.



Furnace—No. 1,415,183. Joel Lund, San Francisco. Means for charging and discharging, and firing, a furnace of the design shown in the illustration.

SOCIETIES, ADDRESSES, AND REPORTS

Engineers Will Investigate Muscle Shoals Power Project

Executive Board of American Engineering Council Passes Resolution to Learn the Truth

The organized engineers of the country will attempt to solve the problems of Muscle Shoals. Through the Executive Board of the American Engineering Council at its closing session in Boston, Friday, Sept. 8, the Federated American Engineering Societies adopted a resolution authorizing the appointment of a committee of leading engineers to study thoroughly every phase of the Muscle Shoals problem in order to clear away what was described as "a hopeless muddle" which might lead to grave national disadvantage. In a spirited speech supporting the resolution, Philip N. Moore denounced the proposal of Henry Ford, citing figures tending to show that acceptance of this proposal by the Government would be unwise.

Stating what he called the elements of the proposition and declaring that "committees of Congress have obscured the situation," Mr. Moore said that:

"Enthusiastic politicians, hopeful idealists, bargain-demanding farmers, and success-hunting manufacturers ask the expenditure of great sums of public money, in order that it may be leased to a private individual for 100 years, upon terms which, as estimated by a distinguished civilian engineer, if charged with 4 per cent compound interest, and the rental payments credited by same will at expiration have cost the government \$1,278,000,000 more than the receipts from the lessor.

"The elements of this enterprise have never been laid clearly before the public by a body of competent engineers who could be universally recognized as having no interest other than the truth."

The president of the Federated American Engineering Societies, Dean Mortimer E. Cooley of the University of Michigan, was directed "to appoint a committee of disinterested, distinguished and skillful engineers, to be selected by a special committee of the Executive Board, and approved by the Committee on Procedure, for the purpose of making a thorough study of the assembled facts regarding the Muscle Shoals proposition, this committee to serve without compensation."

The Muscle Shoals resolution provides that the committee of engineers chosen to make the study "shall submit to the Committee on Procedure, and subsequently to the Executive Board, an outline of the scope of the investigation proposed."

The resolution, which gets underway one of the biggest volunteer enterprises ever undertaken by American engineers, declares that the results of this study will constitute "a service of great and possibly determinative value to the nation" in the settlement of the controversy over Muscle Shoals.

Calvert Townley, of New York, vice-president of the Westinghouse Electric & Manufacturing Co. and past president of the A.I.E.E., is chairman of the Committee on Procedure, which has finally approved the personnel of the committee of engineers chosen to make the Muscle Shoals inquiry. Other members of the committee are Dean Dexter S. Kimball of Cornell University, president of the A.S.M.E.; J. Parke Channing, of New York; W. E. Rolfe, St. Louis; W. W. Varney, Baltimore; H. E. Howe, Washington. President Cooley stated that enough effort will be made to place at the disposal of the nation the services of America's best engineering ability.

Three Shifts Advisable in Practically All Industries

Federated American Engineering Societies Reports on Work Periods

"The tendency throughout the world is toward the abolition of the twelve-hour shift," declares the report of the Committee on Work Periods of the American Engineering Council of the Federated American Engineering Societies, which was adopted after a long discussion by the Executive Board of the Council in Boston, Friday, Sept. 8. The report, in effect, finds that the two-shift day of twelve hours each is not an economic necessity in American industry.

"In almost every continuous industry," says the report, "there are plants which are operating on an eight-hour shift basis in competition with twelve-hour shift plants." It is also shown that in practically every major continuous industry plants which have changed from twelve hours to eight hours have increased the quantity of production per man up to as much as twenty-five per cent. In a few cases, the report states, the increase has been much higher. In the steel and iron industry, which is made the subject of a special report, it was found that "the change from the twelve to the eight-hour day has secured results sufficient to compensate in whole or in part for the extra cost."

Other advantages of the eight-hour day in the steel and iron industry are described as increased efficiency, better

morale, elimination of the "floating gang," which is maintained to give twelve-hour men a day off a week, and greater prestige of the industry with the public.

Prof. Samuel McCune Lindsay, of Columbia University, representing the Cabot Fund of Boston, officially styled the report as embodying the results of "the most important investigation of any industrial situation ever undertaken in this country."

One part of the report, that by Bradley Stoughton on the iron and steel industry, finds that the eight-hour day makes better men physically and mentally, attracts a better class of men to the industry, improves conduct of operation, makes operation more uniform, betters the quality of product, uses less fuel, involves less waste and less repairs to equipment, and lengthens the life of apparatus. These advantages, the Stoughton report says, are bound up in "increased efficiency manifested in increased production per man per hour and per machine per day."

The eight-hour day, it is declared, produces better morale among workers, resulting in less absence and tardiness, less shirking and better discipline, which results from "better spirit of the men and the greater pressure which foremen can and will exert because they do not have to hold back out of sympathy for tired men."

According to the Stoughton report, there are altogether about 150,000 wage earners in the entire steel industry on twelve-hour shifts. The report makes recommendations for successful and economic change from the two-shift operation.

Origin of Petroleum Discussed at Chemical Society Meeting

Two papers on the origin of petroleum were presented at the sixty-fourth meeting of the American Chemical Society at Pittsburgh on Sept. 6. One, by R. E. Somers, discussed "The Origin, Migration, and Accumulation of Oil and Gas," and the other, by Reinhardt Thiessen, "The Probable Mother Substance of Petroleum." According to Mr. Somers, the inorganic theories of origin, such as that of Mendeleef, are geologically impossible for large amounts of oil and gas, the organic theories better accounting for the commercial pools. The effects of geologic alteration continue beyond the first formation of oil and gas, and, according to White's laws, lighter fractions are added with increasing pressure and longer time. Geologically older oils are lighter in weight.

MEN YOU SHOULD KNOW ABOUT

Edwin E. Chase is in Butte, Mont., on professional business.

R. C. Warriner, of New York, is visiting Cobalt and Kirkland Lake, Ont.

C. M. Weld, of Weld & Liddell, has returned to New York from Montana.

A. A. Mackay is in Atlin, B. C., making an examination of the Engineer mine.

Robert March is in Ely, Nev., to take charge of the Consolidated Copper mines.

H. B. Wills, president of the Vipond, has been making an inspection of the property.

I. D. Daimpre, who has spent the last several months in northern Manitoba, is visiting Cobalt.

Dr. Kuno B. Heberlein has returned to New York after a six months' business trip through Europe.

W. C. Mendenhall, of the Geological Survey's Land Classification Board, has returned from an extended trip throughout the West.

C. E. Dobbin and A. H. Redfield, of the U. S. Geological Survey, have returned to Washington from field work on the graphite deposits of Alabama.

Louis S. Cates, general manager of the Utah Copper Co., recently visited Ray and Jerome, Ariz. At Jerome he attended a meeting of the Hull Copper Co.

G. E. Harrison, district superintendent at Crystal Falls, Mich., for the McKinney Steel Co., was a recent visitor on the Mesabi and Vermilion ranges.

Harry Pickands, a member of the firm of Pickands Mather & Co., is making a tour of inspection of the company's properties on the Lake Superior iron ranges.

Dr. Walter Harvey Weed, of New York, has been engaged by mining interests in the West Shiningtree gold area of Ontario to make a geological report on claims in that field.

C. P. Bowie, who is attached to the Bureau of Mines station at Berkeley, Cal., has been called to Washington temporarily to assist F. B. Tough, the new chief petroleum technologist.

R. A. F. Penrose, Jr., arrived in New York on the "S. S. Homeric" on Sept. 7, on his return from Brussels where he attended the International Geological Congress, which, he says, was a great success in every respect.

S. Livingston Mather, secretary of the Cleveland-Cliffs Iron Co., has completed a business trip to the iron ranges in Minnesota relative to the properties of his company. From Minnesota, he left for the iron ranges in Michigan.

The appointment of Arthur W. Ambrose as assistant director of the U. S. Bureau of Mines, to give special attention to the petroleum industry, as announced last week, calls attention to the rapid increase in importance of the Bureau's petroleum work. The petroleum division was established as a



A. W. Ambrose

separate entity within the Bureau on July 1, 1914. At that time, its appropriations and its personnel were small, as compared with the other divisions of the Bureau. The petroleum work has increased in importance until now the



F. J. Bailey

petroleum division disburses more of the Bureau's funds than does any other division. Mr. Ambrose comes originally from Lodi, Calif. His technical education was obtained at Stanford University, where he secured his mining engineer's degree. Prior to his employment by the Bureau of Mines in 1917 he was in the service of the Dutch Shell and other petroleum companies. Just prior to his appointment as chief petroleum tech-

nologist, two years ago, he was superintendent of the petroleum experiment station at Bartlesville, Okla. F. J. Bailey, who, as assistant to the director, will take over a portion of the duties formerly assigned to the assistant director, is a graduate of Middlebury College, Vt., and a graduate in law from George Washington University. He has been with the Bureau of Mines since its organization in 1910. As assistant to the director he has already had charge of a large part of the work, including the Mine Safety Service.

Joseph Clendenin, sales manager of Guggenheim Bros.; R. L. Agassiz, president of the Calumet & Hecla Mining Co., and Edward Mosehauer, of the United Metals Selling Co., sailed for Europe on Sept. 9 in connection with affairs of the Copper Export Association.

Andrew P. Mayberry, of Salt Lake City, has been retained as consulting engineer for the Eureka Mining & Smelting Co. of Eureka, Nev. Mr. Mayberry plans to spend a week or ten days each month in Eureka, supervising development work, especially in relation to the reduction of mining costs.

L. E. Hanley, of Wallace, Idaho, has been advanced to the position of general superintendent of the Hecla mine and mill. Mr. Hanley has been in charge of the main office, and purchasing agent for the company. He is a graduate mining engineer and metallurgist and has been connected with the company for nineteen years.

Mining and metallurgical engineers visiting New York City last week included: F. G. Lasier, of Detroit, Mich.; F. W. Foote, of Boston, Mass.; E. O. Daue, of Philadelphia, Pa.; M. F. Sayre, of Schenectady, N. Y.; and Stuart B. Marshall, of Washington, D. C.

OBITUARY

Dr. G. H. Cox, geologist for the Josey Oil Co., of Okmulgee, Okla., was killed in an automobile accident on the night of August 19. Dr. Cox was graduated from the Northwestern University in 1905 with the degree of Bachelor of Arts. He took post-graduate work at the University of Wisconsin and received the degree of Ph.D. there in 1911. He also received the degree of E.M. from the Missouri School of Mines and Metallurgy. He was a member of the honorary fraternities Sigma Psi and Tau Beta Pi. Dr. Cox was professor of geology and mineralogy at the Missouri School of Mines and Metallurgy from 1909 to 1920. He was well known in the mining profession, having published a number of geological papers. He was the senior author of "Field Methods in Petroleum Geology," by Cox, Dake and Muilenberg, a standard text on that subject.

THE MINING NEWS

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Leading Events

MINING COMPANIES in Utah, Arizona and other western states have voluntarily increased wages. This is the logical consequence of the shortage of competent labor that has existed since the resumption of production by the copper-mining companies six months ago.

The Russo-Asiatic Corporation has made an agreement with Krassin under terms of which mining in the Urals and Siberia will be resumed.

The O'Brien mill and headframe at Cobalt, Ont., have been destroyed by fire.

Iron ore shipments from Lake Superior points exceed those of a year ago by a wide margin.

The Utah Copper Co. is reported to have made 9-cent metal in June.

New interests have acquired options on the Middle Mines group on the Comstock Lode in Nevada. Immediate development is planned.

The Granby Consolidated Mining, Smelting & Power Co. will increase its copper output.

A new departure is the establishment of a clearing house for prospectors in Spokane, Wash.

Wages Increased 10 Per Cent at Globe, Ariz.

Serious Shortage of Miners Forces Action—Scale Now Back to War Maximum

Operating executives of mining companies in the Globe-Miami district of Arizona have agreed on a voluntary increase in wages of 10 per cent. This was agreed upon at a conference of mine managers.

There are at present between 3,500 and 4,000 men employed in the district. The larger properties are the Inspiration, Miami, Old Dominion, and Arizona Commercial Mining Co. The present scale is \$4 per day for muckers and \$4.50 per day for miners and semi-skilled workers. Under the new rate common labor and miners will be paid \$4.40 and \$4.95 per day respectively. The new scale puts wages back to virtually the high level of the war period, this latest advance representing an increase of \$1.95 and \$1.40 per day above the 1913 rate.

There has been an alarming increase in the number of mining workers leaving the copper camps for the oil fields of the mid-west and Montana, for the harvest fields and for industrial centers. The automobile factories of Michigan and vicinity have drawn thousands from the Lake copper country, there being today fewer than 5,000 in the whole district, against normal forces of 13,000. The wage increase is expected to be of some help in obtaining adequate forces.

On Oct. 1 the Calumet & Arizona Mining Co. and its subsidiary, the New Cornelia Copper Co., will increase wages of their 1,500 employees in Arizona 10 per cent.

This is in line with the policy of all

the mines in the state of Arizona. As one mining executive says: "This is not because the metal market and earnings of mining companies warrant the increase, but because conditions make it necessary." There has been an alarming increase in the number of mining workers who have sought other fields of endeavor in the last year. Many who left the camps when the mines were forced to suspend operations in April a year ago have not returned. The oil industry, the farms, and the automobile factories, have taken thousands of mining workmen from the copper camps.

Clearing House for Prospectors Established at Spokane—Scheme Is Novel

An association known as the International Association for Mineral Development has recently been organized in Spokane, Wash. The purpose of the organization is to promote interest in the mineral resources of the northwestern United States and western Canada and to act as a clearing house between the prospectors and mining capital seeking investment. Worthy prospects and mines for sale are to be listed by the association and provision is made in the by-laws to employ competent technical advice in assembling authentic data in detail on all properties proposed for sale. The organization may also grubstake prospectors to develop prospects, and to prospect likely areas, and representatives are appointed in many cities to present listings of the association. Since its recent organization over 200 names have been put on the rolls of the organization.

Rowland King, of C. M. Fassett, Inc., metallurgists, is president, F. M. Handy, formerly professor of geology of Washington State College is vice-president, and A. R. Moore is secretary.

Russo-Asiatic Corporation Comes to Terms with Krassin

Agreement Involves German Financial Interests Instead of American—Terms Are Favorable

An agreement by which the Russo-Asiatic Corporation obtains a ninety-nine year lease on vast mining properties in the Russian Urals and Siberia was signed in Berlin on Sept. 9 by Leslie Urquhart, head of the corporation, and Leonid Krassin, Soviet Minister of Trade and Commerce, according to a special dispatch to the *New York World* dated Sept. 10. All the old mines operated by the company are included.

The contract provides that the corporation's title to the property becomes absolute if in the future the Russian Government decides to recognize private property rights.

This is the first separate agreement of a British firm with Moscow following failure of the Genoa and The Hague Conferences. It is expected more will follow, but it is significant that Urquhart is associated with the German Krupps in the deal.

The corporation built up vast mining properties in the Urals with the backing of British and American financiers. It turned the nomad population into mine workers, and all through the Bolshevik regime kept in touch with them, even feeding them at times.

It was these workers who made the signing of the agreement possible. Urquhart had been negotiating with the Russian Government several times during the year, but they were not able to agree on terms until the Ural laborers petitioned the Government to allow resumption at the mines.

Under the agreement the company gets full control of the railroad and the

mines. The only condition is that Russian labor laws must be observed in hiring and discharging workers. There is no local Soviet in this mining empire, and the company will practically rule its workers and the wandering tribes of the district as well.

Most of the technical experts who will be employed to reopen the mines will be Americans, chiefly because Herbert Hoover was for a long time connected with the development of the mines. But American financial interests will be replaced by the Krupps and the German bankers Mendelssohn & Co.

According to the report the concession permits the reopening of mines which produce 70 per cent of Russia's copper, all her zinc and lead and over 20 per cent of the gold. Coal and iron mines, iron and steel works, 300 miles of railroad and 2,500,000 acres of land are included in the deal. Over 45,000 workers, supporting 250,000 persons, will be employed.

West Australian Gold Output

*By Cable from Reuters to
"Engineering and Mining Journal-Press"*

London, Sept. 8—The gold output in Western Australia for August was 49,689 ounces.

Fire Destroys O'Brien Mill at Cobalt, Ont.—Loss \$250,000

On Sept. 4 at Cobalt, Ont., the O'Brien mill and headframe were completely destroyed by fire, with an estimated loss of \$250,000. One hundred men were thrown out of work. The fire started in an electric concentrate drier, and, as it was Labor Day, there was practically no one on the property. It has not been announced whether the mill will be rebuilt or the ore treated in customs mills. It is believed that any of the operating plants would make reasonable terms for milling the O'Brien ore.

Opportunities for Canada's Mineral Products Abroad

Dr. Charles C. Camsell, Canadian Deputy Minister of Mines, who is at present in England endeavoring to open up new markets for Canadian mineral products, states that his visit has convinced him that Canada can replace in Europe the markets closed to her in the United States by the revised tariff. It will, however, require organization on the part of mineral producers and co-operation by the purchasers. He has ascertained what European purchasers want, how they want it, and what they are prepared to pay for it, the principal minerals in requisition being graphite, mica, feldspar, and talc, though tar sands and bentonite clay have also been considered. If small Canadian producers will get together and make use of this information they will be assisted by the Imperial Mineral Resources Bureau in London. Dr. Camsell investigated the German process of briquetting low-grade coal, but does not consider it practicable for Canadian coal.

Lake Superior Shipments of Iron Ore Greatly Exceed Last Season's

Iron ore shipments from the head of the Great Lakes in August reached a total of 9,015,982 tons, bringing the season's total up to 26,309,871 tons, which is far above the total for the same month and season of last year, when shipments for August totaled 4,329,158 and the season totaled 14,748,072. If the present rate of shipments continues, the estimated tonnage of 45,000,000 will be exceeded. Every indication tends to show that this rate of shipment will continue.

Phelps Dodge Company Commences Lease on Perth Amboy Refinery

Arrangements are being completed whereby on Oct. 1 the Phelps Dodge Corporation commences the use of the Perth Amboy refinery of the American Smelting & Refining Co. The Smelting Co. is to conduct the operations, although the plant is being leased for a term of years to Phelps Dodge.

With the P. D. copper will go that of the Calumet & Arizona Mining Co. which markets through the P. D. agency and which had been shipping for years to the Nichols Copper Co. at its Laurel Hill refinery. The Perth Amboy plant, which is also equipped to smelt and refine other metals, is to continue its other operations as heretofore.

Through the new business arrangements the Smelting company is assured of steady income from a plant which had suffered from the excess of refining capacity in the country.

Tom Reed Sampling Mill Should Stimulate Mining at Oatman, Ariz.

The sampling mill of the Tom Reed Gold Mines Co. at Oatman, Ariz., is being installed on foundations that have been in place for weeks past. Operation of the plant is expected to start a score of small mines of the district, with the facilities offered for disposal of small batches of ore. On the Tom Reed 500-ft. level, near the Telluride line, a body of ore is reported to have been cut unexpectedly, of which several feet is high grade.

The Gold Dust company will ship to the Tom Reed sampler from a large body exposed on the 300 level. The Telluride is deepening its main shaft 300 ft., to reach ore already developed in a winze. Operations have been resumed on the Black Range, which is to be explored through the adjoining Nellie.

Czechoslovak Iron Prices Reduced

*By Cable from Reuters to
"Engineering and Mining Journal-Press"*

London, Sept. 8—Reports from Prague state that Czechoslovakian iron producers, in order to bring their prices into line with foreign quotations, are reducing prices of various descriptions of iron by thirty to one hundred crowns per hundred kilograms.

Braden Is Producing 10,000,000 Lb. of Copper Monthly in Chile

The Braden Copper Mines Co. is now treating about 10,000 tons of ore daily for a monthly production approximating 10,000,000 lb. of copper at its South American mines. The cost, including depreciation and depletion, is estimated at 8½c. a pound.

Including the proceeds from sale of securities and earnings put back into the property there has been spent on Braden to date upwards of \$40,000,000. Its early progress was somewhat retarded through lack of vision of the managers, who failed to foresee the ultimate size of the property. Hence the expansion of an original 2,000-ton plant to 10,000-ton, which has been costly and also slow work. It is now planned, at the cost of about \$1,500,000, to enlarge further the mill capacity to about 15,000 tons of ore daily.

Private Enterprise Will Develop Mineral Deposits in Netherlands-India

A telegram to Reuters from Batavia dated Aug. 17 states that the Government of Netherlands-India appears to have decided to abandon the principle of the working of mineral deposits by the state, preferring to leave the exploitation to private initiative. It is stated that the important deposits of iron ore recently investigated by an official commission sent by the government to the Celebes will be worked by private capitalists, the project of the enterprise being conducted by the state having been abandoned. The same will be the case with regard to the various deposits of tin and gold, and petroleum wells presumably will come under the same policy.

Success Oreshoot Developed for 200 Ft.

The new oreshoot first entered a few months ago at the Success mine in the Coeur d'Alene district of Idaho has now been proved for length of 200 ft. Drifting continues to the west in the same high-grade lead-silver ore with varying quantities of zinc, and there are no indications that the end of the shoot is being approached. This discovery was made on the 700-ft. or main-tunnel level in a large block of ground that had been classed as without possible mineral value, and is the result of following a stringer of ore in the station wall that was hardly half an inch thick. The ore has been crosscut in only one place where it was 27 ft. wide. Preparation is now being made to open up stopes, and this will be followed by unwatering the shaft down to the next level, 160 ft. below, from which a crosscut will be run to the new orebody. This new oreshoot is expected to add many years of profitable life to the Success mine, which had a doubtful future prior to this discovery. The company has a mill of 250-ton capacity.

Michigan Copper Mining Companies Expect to Pay High for Coal—May Be Short

Coal receipts in the Lake Superior copper country during August were only 19,562 tons as compared with 96,502 tons in August a year ago and 46,812 tons in July this year. The fuel situation continues a serious one for the mines so far as winter operations are concerned, and one or two producers are very low on stocks even for present operations. Ordinarily the mines stock heavily with coal, some of them a year in advance, but they will be fortunate this year if receipts are sufficient to prevent a shutdown part of the winter. There is still hope that enough coal will be received during the remaining two months of navigation to enable the mines to operate until April 1, when coal can again be received by boat. It is expected, however, that abnormal prices will have to be paid.

Colorado Mines Use More Power

The latest income statement of the Colorado Power Co., whose business is derived chiefly from the metal mining districts of the state, shows a decided increase over like periods of last year. The report says: "There is indisputable evidence in earnings that the state has made the turn from its period of business depression and while we still are below the peak, prospects for better earnings in every line were never better. Increased demand for power in the mining districts is notable and encouraging, not only to this utility, but because of the stimulating effect of a mining revival."

Tungsten Mining Companies in Tasmania Combine

With a view to joint working on an economic basis, shareholders of five companies and three syndicates operating mainly for wolfram ores in the Moina district, southwest from Sheffield, northwestern Tasmania, have formed one large company of 500,000 shares of £1 each, according to Reuter's correspondent in Melbourne. Under the plan, which has been adopted by meetings of all the companies held recently in Melbourne, the consideration of the transfer of assets (with existing liabilities) will be fully paid shares and cash, as follows: South All Nations, 90,000 shares and £24,000; All Nations, 30,000 shares and £9,000; North Iris Main Reefing, 48,000 shares and £9,600; North Iris, 12,000 shares and £6,000; Cannon G.M. Co., 5,000 shares and £4,000; East All Nations, 2,000 shares and £2,000; Lawson and Riley, £4,000. The companies thus will receive 189,000 fully paid £1 shares and £59,600 in cash, but the latter will be paid only out of metal produced by the amalgamated concern, at the rate of 25 per cent of production, and, in the interim, will carry 6 per cent interest.

It is intended to put in a tunnel from Lawson and Riley's section, and erect a complete plant in the most convenient position. Ore on the South

All Nations property is reported to have been proved at 6 to 14 per cent of wolfram, and the lode traced for 950 ft., while an average value throughout of the block to be operated from the new tunnel is expected of over 2 per cent wolfram.

Wages Advance in Michigan Iron Ranges

The mining companies on the Michigan iron ranges have advanced wages approximately 10 per cent. This came after the steel companies had made advances at the steel centers in the east and middle west. Labor is not plentiful in the Lake Superior country, being quite scarce in the copper district, and it was thought advisable to make the advance in order to hold the men. Many have removed to industrial centers, but it is thought that some will return when the automobile business slackens during the winter months.

Tonopah Mining Co. Plans Active Development of Cripple Creek Property Recently Acquired

Mining men of the Cripple Creek district in Colorado are encouraged by the entrance of the Tonopah Mining Co., which has recently taken over the Ajax properties and will operate them under the name of the Tonopah-Ajax Mining Co. The property includes 33 acres on Battle Mountain adjoined on one side by the Portland and on the other by the Granite holdings. There is a three compartment shaft 2,000 ft. deep and fourteen miles of workings from the main shaft. It is said that the new management plans extensive development from present levels and, ultimately, to sink to greater depth. The Tonopah company recently commenced operations in Clear Creek County and for several years past has been operating a gold dredge in Summit County.

News from Washington

By PAUL WOOTON
Special Correspondent

Mine Products Form Important Part of Panama Canal Traffic

West-Bound Traffic Exceeds Pacific-to-Atlantic by One-Third
—Statistics for First Half of 1922 Show Increased Volume of Traffic

AN ANALYSIS of the traffic through the Panama Canal for the first six months of 1922 shows the Atlantic-to-Pacific traffic to have been greater by approximately one-third than the Pacific-to-Atlantic movement. The greater amount of tonnage moving from the Atlantic to the Pacific is due to the fact that many of the vessels going through the Canal under load for Australasia and the Orient find it more to their advantage to return by way of the Suez Canal, that route affording a better opportunity to secure a return cargo than does the trip back across the Pacific. In the earlier years of Canal traffic the Pacific-to-Atlantic tonnage was the greater, according to Panama Canal statisticians. The considerable reduction in that movement is attributed to the marked decline in tonnage originating in South America and the Far East. On the other hand, tonnage from the west coast of the United States, Canada, Central America and Mexico has increased decidedly. The figures for the mineral commodities moving east-bound through the Canal during the first six months of 1922 are as follows: Nitrate, 275,419 tons, a decrease of more than 100,000 tons from the movement during the first six months of 1921; ores, 108,987 tons, an increase from 65,638 tons for the corresponding period of 1921; metals, 101,005 tons, an increase from 76,605 tons in 1921; oils, 175,632 tons, an increase from 127,961 tons in 1921.

The west-bound movement of mineral commodities through the Canal

during the first six months of 1922, with comparisons for the corresponding period of 1921, follows: Crude oil, 270,165 tons, a decrease from 684,177 tons for 1921; coal and coke, 235,188 tons, a decrease from 370,160 tons for 1921; metals, 110,479 tons, an increase from 32,645 for 1921; sulphur, 63,048 tons, a decrease from 71,014 tons for 1921.

The movement of metals from the Pacific to the Atlantic is made up largely of copper, lead and tin, with some movement of zinc, iron, and antimony. While the bulk of the copper movement is from the west coast of South America, more than one-third of the tonnage came from the west coast of the United States. The west coast of Canada contributed importantly to the movement. Australia contributes the largest amount of the lead tonnage, with the west coast of the United States a close second and the west coast of Canada following.

The ore movement, in order of volume of tonnage, is as follows: Copper, iron, tin, gold and silver, antimony, chrome, lead, zinc, magnesite, manganese, tungsten. More than 90 per cent of the copper ore during the full fiscal year of 1922 originated on the west coast of South America. The west coast of the United States and the west coast of Canada supplied the remainder. All of the iron ore tonnage originated on the west coast of South America. The chrome came entirely from Australasia and the antimony from the Far East.

Gold Reverts to Foreign Countries Through Purchase of Securities

United States Does Share in Rehabilitation of World by Foreign Financing

That the United States is doing its share toward the maintenance of the gold standard and the rehabilitation of the world by purchasing foreign securities and extending credits was contended by E. R. Crissinger, the Comptroller of the Currency, in an address before the Indiana Bankers' Association at Indianapolis on Sept. 13. An extract from his remarks, follows:

"A year ago, two years ago, we were all agreed that the gold standard could not be maintained in the world if all the gold were to come to America. From 1915 on, it had been persistently flowing to us from every land and every quarter. At first we had received it with satisfaction and gratification, as evidence of our increasing wealth and abounding prosperity. There came a time when we realized that if too much of it came to us, if the gold standard were to be broken down in the world, the gold itself would be of mighty little value to us. We began to be told that we must take credits, securities, bonds, stocks, rather than gold; and before long we realized that this was true. We began first to take the bonds of the allied nations; then to buy the securities that stood for their industries and enterprises, which came seeking from us that same financial support which the Old World had given to us in our nineteenth century epoch of rapid development.

"I read the other day that thus far this year the sales of foreign securities in the United States had averaged something like twenty million dollars every week. I don't know how accurate the figures are, for I have no better access to the details than the rest of you have. I do know that day by day, week by week, month by month, we have all seen the financial advertising through which American investors have been offered the securities of almost all the countries under the sun. Only the other day, one hundred and eighty-five million dollars of bonds of the Republic of Argentina were authorized to be sold in this country. We have taken the securities of the City of Rio de Janeiro and the Republic of Brazil; we have bought the securities of the East India Company of Holland, of the Royal Dutch Oil Corporation, of the cities of France, the government of China, the governments, the provinces, the peoples, the incorporated companies of the whole world.

"Are we doing our share toward the rehabilitation of the world? I undertake to say that when American investors buy two hundred million dollars of South American government securities—of securities which ten years ago would have been placed in Europe—we are literally and actually releasing that amount of credit and financial resource to serve the immediate needs of Europe. Europe in the last seven years, by way of financing itself, has been selling off its holdings of securities throughout the world. We have been taking them; and to that extent have been lifting from Europe the burden of financing the world.

Bureau of Mines Seeks New Uses for Tellurium

Byproduct of Copper Refineries Is In Small Demand

The finding of new uses for the mineral tellurium would render marketable a byproduct of which the copper refineries of the country can produce 125,000 lb. annually, but for which there is little present demand, states the United States Bureau of Mines. Although the mineral possesses various rather remarkable characteristics, present uses are so limited that the demand is supplied by a few hundred pounds per year. Tellurium is a silver white solid with metallic luster, the crystalline form being very brittle and easily powdered. It melts at 452 deg. C. The chemistry of tellurium is similar to that of sulphur. From its chemical nature, tellurium is now known to be a non-metallic element, belonging to the sulphur-oxygen group. Tellurium is most popularly known through its occurrence in gold ores. Most gold and silver ores and particularly copper ores contain tellurium. In the course of smelting and refining these ores, tellurium is found in concentrated form in the flue dust of smelters, electrolytic slimes, and in the fumes and slags resulting from cupellation. The whole commercial supply of the element is obtained as a byproduct from copper ores. Pyrite and sulphur used in the manufacture of sulphuric acid, also contain tellurium as it is

found in the flue dust and acid sludge.

Efforts have been made by Government agencies in co-operation with copper refiners to discover new uses for tellurium, but no important results have been reported. It has been used in a small way in high-resistance and other alloys, in organic dyes, for staining silver, in medicine, and as a reagent in chemical laboratories. As a coloring agent in glass or porcelain, blue, brown, and red colors may be produced by tellurium, some of the best ceramics being colored in this way. Tellurium dissolved in sodium sulphide solution is used in toning baths for photographic prints. Tellurium dioxide at red heat is a powerful oxidizing agent decomposing completely even lumps of steel or metal alloys. Its chemical similarity to sulphur suggests many possible uses. It might be used, for instance, as telluride in coloring lithopone and the extension of the use of tellurium might well be studied in connection with the iron and steel industry.

Three More War Minerals Awards Made

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commissioner has recommended the following awards: Dennison, Adler and Beatty, Cushman, Ark., \$7,585.43 (additional); E. N. Fessier, Stockton, Calif., \$2,238.20; Alexander Egenes, Greenwood, Calif., \$2,174.62.

News by Mining Districts

London Letter

Reports Indicate Improved Position for Cam & Motor—New South African Gold Strikes Still Uncertain

By W. A. DOMAN

London, Sept. 1—Since the reorganization of the treatment plant at the Cam & Motor mine (Rhodesia) prospects have improved and according to the brief cablegram from the property the ore reserve position is stronger than was at one time expected. At June 30, 1921, the reserves were calculated at 600,000 tons of an average gold content of 38.21 s. At June 30 last the estimate was 680,000 tons with gold valued at 39.9 s. As in the meantime 168,700 tons was milled, the new ore brought into sight was 248,700 tons. The message being brief it is not made clear whether any alteration has taken place in the stoping width, and consequently it is impossible to determine whether the whole of the addition mentioned above is really "new." In any case it matters little, seeing that the gold value is 1.69s. higher. Here again is an uncertain factor, as it is not stated whether the standard or the market price of gold is given. This point, perhaps, is of more interest to the technical profession than to shareholders. The ore reserves value at June 30 last enables a comparison to be made with the working results for the quarter

ended the same date. I give the figures in a manner rather different from that taken by the management, though the outcome is naturally identical. During the three months 44,200 tons of ore were milled for a yield of 16,264 oz. of gold, or 7.35 dwt., equal at 85s. to 31.23s. per ton. The output report cannot be expected to give full details, so that it is impossible to tell whether a lower than average grade of rock was treated, or whether extraction was low. The figure of 31.23s. per ton, it will be noted, compares with 39.9s. for the whole of the reserves. The mine yield was £68,972, and after deducting royalty to the B. S. A. Company (£4,208), and adding sundry revenue, the total for the quarter was £64,926. Working costs, including £7,182 on development redemption, were £59,513, leaving a working profit of £5,413. Into the revenue was taken premium reserve of £6,000, and a gold reserve of £9,169, raising the profit reported for the quarter to £20,582. The total expended on development was £13,799, a sum of £6,617 being laid out on capital account, in addition to the amount redeemed. As development embraced 2,043 ft. the average per foot was £6.7.

Further information has come to hand concerning the recently reported gold discovery near Bechuanaland. There is a good deal of wild talk, such as, for instance, reef extending for a distance

of 170 miles. Apparently, the people mainly interested are saying little, the object of their silence being presumably to get more definite information first. Assays are mentioned from 7 dwt. to 8 oz. to the ton, the lower estimates having reference to government ground. Some of the farms containing the formation are said to belong to great land-owning companies who prefer to leave the song-making until a later date.

Johannesburg Letter

Production Figures for July—South African Institute Members Visit Dam Construction Project

By JOHN WATSON

Johannesburg, Aug. 8.—The leading gold-mining groups have just published their returns for the month of July, from which we cull the following:

	Tons Crushed	Value Recovered	Estimated Profit
Govt. G. M. Areas.	141,000	£283,025	£153,899
New Modder.....	108,000	224,074	127,933
Modder B.....	62,000	155,929	86,945
Brakpan.....	64,500	110,537	*75,611
Crown Mines.....	214,000	282,356	67,690
City Deep.....	88,500	173,639	66,712
Modder Deep.....	43,200	106,827	66,257
Van Ryn Deep.....	55,000	120,865	63,000
Randfontein			
Central.....	133,500	189,616	45,025
Springs Mines.....	41,400	80,975	35,071
Geduld.....	46,300	75,853	30,118
Robinson Deep.....	68,400	.....	30,984
Consld. Main Reef	52,100	91,162	23,781

*The Brakpan figure for profit includes £30,330 value of gold from strike cleanup.

On the Crocodile River, at Hartbeestepoort, about 24 miles west of Pretoria, a great engineering enterprise is now under way. This is the formation of a huge dam, which eventually should form a lake having an area of about 40 square miles. It is one of the Union government schemes to find employment for white labor, and at present about 1,400 white men are employed on the construction of a huge curved concrete wall, in the Magalies Hills; a similar number are also employed in forming two canals, which will irrigate the eastern and western slopes of the valley. The works were visited on Aug. 3 by about 70 members (and friends) of the South African Institute of Engineers, including the president, J. W. Kirkland. The distance from Johannesburg is about 60 miles and 20 motor cars were used to convey the above party. An area of 30,000 acres will eventually be put under irrigation. The work is being carried out under the control of A. D. Lewis, M.I.C.E. Director of Irrigation, and J. L. Hill, chief engineer of construction with the assistance of a staff of eight other engineers. The members of the Institute were impressed with the project and with the organization of the work.

E. Kumst, a well-known geologist and prospector, who has been exploring the West Rand reefs for many years, has now pegged over 4,000 claims on the townlands of Krugersdorp and on Hill's Waterval. A reef there, known as the Government Reef, is said to assay 8 dwt. over about 6 feet.

QUEENSLAND

Sardine Tin Mine Thrives—Copper Mining Almost Dead

By Our Special Correspondent.

Brisbane—The now famous Sardine tin mine, in the Kangaroo Hills field, is continuing its profitable career, with the prospect of even better things for the future as further depth is reached. The rising tin market, also, is of course still further helping the company owning the mine. During the past half year, although quite one-quarter of the ore raised came from purely development work, the 708 tons of ore treated gave a return of 181 tons of black tin, the extraction thus giving an average of 26 per cent. In the six months before, 160 tons of tin was obtained from 489 tons of ore. In the short term of the company's existence—two and a half years—it has, notwithstanding the very low price of tin in that period, paid dividends amounting to £28,000 on a paid-up capital of £30,000. A contract has now been let to extend the tunnel that forms the main part of the working another 200 ft., and this extension is expected to intersect several formations showing on the surface.

Several other tin mines in the same locality as the Sardine are developing well, and are promising increased outputs with a rising tin market. The latest addition to these mines is the Canary, which was discovered towards the end of last year. It is located 2½ miles away from the Sardine, on quite a distinct lode. The outcrop was 15 ft. in length, and at a depth of 32 ft. an average of 38 per cent ore was obtained over that length. Later recoveries gave an average of nearly 39 per cent of black tin, and quite recent crushings have had equally good results.

ONTARIO

Beaver Vein May Be Explored—Dome Produced \$352,774 in August

Cobalt—It is understood that a deal for the control of the Beaver is being negotiated by the Coniagas. The Beaver discovered a large vein at 1,200 ft., which is below the lower diabase-Keewatin contact. The company did not have sufficient funds to prospect the possibilities thoroughly. The property has been closed for the last two years.

Kirkland Lake—It is reported that no further financing is necessary for the Argonaut. Over \$750,000 has been spent on the property to date. Funds are available to complete the mill.

Porcupine—Sinking the Vipond shaft to 1,000 ft. has been delayed on account of heavy flow of water at 900 ft. Sinking will be resumed as soon as heavier pumps are installed.

The Dome company's August recovery was \$352,774 from 35,000 tons, an average of \$10.08 a ton. This compares with \$335,254 in July and \$351,531 in June.

Davidson has been financed to the extent of \$900,000, and work will be resumed immediately. The first work

will be the sinking of a 1,000-ft. shaft and plans will be made for mill construction.

Skead Township—The shareholders of the Skead Gold Mines on Sept. 7, approved the agreement to give an option to interests represented by A. D. Miles on six claims with a total area of 240 acres, on which high gold assays are stated to have been obtained. If the option is exercised a payment of \$250,000 must be made in six months. British capital is stated to be largely interested.

BRITISH COLUMBIA

Granby Expects to Increase Rate of Output and to Decrease Cost to 8c. Per Pound of Copper

Alice Arm—An 18-in. vein carrying native silver and silver sulphides has been struck in the Baldy tunnel, at the Esperanza mine. This is the third strike that has been made in this tunnel within the last few months. The new owners of the mine have about twenty-five tons of high-grade and forty tons of medium-grade ore sacked and at the wharf ready for shipping. A strike of high-grade silver ore is reported from the Alice mine, to the north of the Esperanza.

Anyox—The Granby Consolidated M. S. & P. Co. produced about 12,500,000 lb. of blister copper during the first six months of the present year and expects to produce from 15,000,000 to 18,000,000 lb. during the remaining half. The company has again cut the cost of production, and is said to be turning out blister at 9.5c. per pound, which compares with 11.63c. for last year. It is expected that when the new reservoir is completed a further cut of 1c. to 1½c. will be made. Work on the dam is progressing well, and there is every prospect that increased power will soon be available.

Grand Forks—Louis Clery has bonded the Revenge mine, at Beaverdell, for \$35,000, and has made a cash payment of 10 per cent of the purchase price. By the terms of the option 50 per cent of all net smelter returns are to go toward the payment of the balance. George S. Bailey, of Republic, superintendent for the Day interests, and G. W. Fairweather have made an examination of the Combination mine, at the junction of Eholt and Boundary creeks.

Trail—Following is a statement of the ore shipments received at the plant of the Consolidated Mining and Smelting Co. for the period Aug. 22 to 31, inclusive.

Name of Mine and Locality	Grass Tons
Black Rock (Zn)—Northport, Wn...	137
Bell—Beaverdell	42
Ottawa—Slocan City	12
Monarch—Field	40
Northport S. & R. Co.—Northport, Wn.	187
Quilp—Republic	51
Rambler—Rambler	45
Surprise Republic—Republic	218
Silversmith (lead)—Sandon	191
Silversmith (zinc)—Sandon	178
Sovereign (zinc)—Alamo	42
Company (zinc)	10,988
Total	12,131

TEXAS

Union Sulphur Co. Acquires
Large Area

Freeport—It has been announced by the Texas Exploration Co., that this company and the Universal Sulphur Products Co. have sold their sulphur rights at Damon Mound, Brazoria County, to the Union Sulphur Co., of Louisiana. The area involved is said to be 3,814 acres. Three to five years ago, the Texas Exploration Co. carried out an extensive development work on this dome, proving a large body of sulphur. The Union Sulphur Co. will be the operating company while the Texas Exploration and Universal companies will share in any profits in addition to receiving a cash consideration.

CALIFORNIA

New Ore in Moore Mine—W. J. Loring
May Extend Operations—Details
of Argonaut Fire

By Our Special Correspondent.

San Francisco—The Moore mine, in Amador County, reports development of ore on the 600-ft. level. The vein is a continuation of the one on the 500-ft. level. The work underground is progressing satisfactorily, and the company expects to have the stamp mill in operation soon.

The Amador Metals Reduction Co., operated by Hamilton, Beauchamp & Woodworth, of San Francisco, has taken over the plant of the California Slimes Concentrating Co. at the Argonaut mill. It is planned to enlarge the equipment by the addition of units for the treatment of slime and concentrate. The recent disaster at the Argonaut will not interfere with these plans.

W. J. Loring is likely to enter the Nevada County district, where the Iowa Consolidated-Birchville group of 10 claims is being examined.

The Bachman group of mines at Fourth Crossing, Calaveras County, has been bonded by A. E. Allegewahr. Reopening of the properties in the near future is planned. The group consists of the Bachman Big Four, the Native Son, and the Mid Winter.

So much prominence has been given by the daily press to the fire that broke out at the Argonaut mine at Jackson, Amador County, on Sunday, Aug. 27, and which led to the entombing of forty-seven miners, that the details are well known. The principal events in chronological order are as follows:

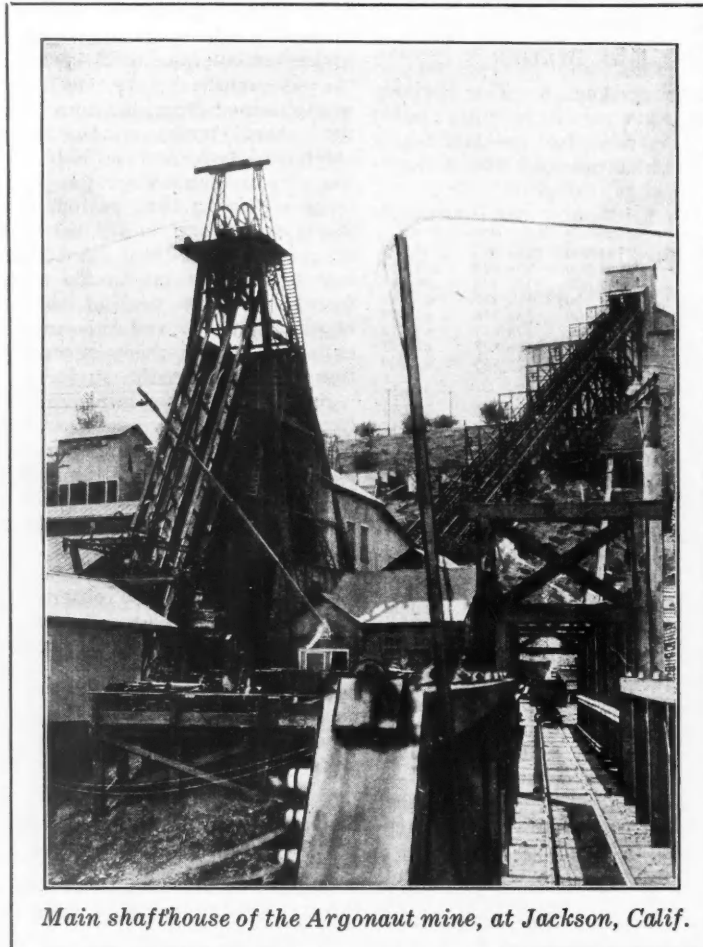
Sunday, Aug. 27.—Clarence Bradshaw, shift boss on the 4,200 level of the mine, tried to signal about midnight to the men working on the 4,500, 4,600 and 4,800 levels, without success. Smoke was then noticed in the shaft, whereupon Bradshaw signaled and, with two skipmen, was taken to the surface. They passed through fire and smoke in the neighborhood of the 3,000 level. Bradshaw, after reaching the surface, made an attempt, with one assistant, to return and reach the imprisoned men, but was overcome with gas at the 2,800 level and was again hauled to the surface.

Monday, Aug. 28.—Rescue work taken charge of by Byron O. Pickard, of the Berkeley station of the U. S. Bureau of Mines. Work in shaft confined mostly to observation. Timber taken out in hope of breaking path of fire upward. Decision made to drive a tunnel from the 3,600-ft. level of the Kennedy mine adjoining.

Tuesday, Aug. 29.—Driving of tunnels from Kennedy property commenced from the 3,600- and 3,900-ft. levels. U. S. Bureau of Mines rescue car brought by special train from Elko, Nev., to Jackson, arriving in afternoon.

traveled toward the Kennedy property it was necessary to seal the Muldoon, Argonaut, and Kennedy shafts. The mines were reopened after having been flooded. The bulkheading of connecting drives between the two properties led to litigation, which is still pending. But for the lack of communication between the two mines the rescue of the men recently entombed might have been feasible soon after the fire commenced.

The Industrial Accident Commission reports that the Argonaut mine has been inspected sixteen times since January, 1914, the last inspection being



Main shafthouse of the Argonaut mine, at Jackson, Calif.

Wednesday, Aug. 30.—Fire in shaft diminished to insignificant proportions; repair work commenced. Tunneling operations from adjoining property proceeding rapidly.

Thursday, Aug. 31.—Work of rescue delayed by difficult ground. Bulkhead and air pipe being erected across south drive on 2,400-ft. level in the Argonaut shaft, to facilitate ventilation. Repair of shaft and removal of debris continuing.

Friday, Sept. 1.—Rescue work continues. E. A. Stent, vice-president of the Argonaut company, issues statement to press in which it is maintained that rescue cannot be effected in time to save men.

It will be recalled that, because of the fire that broke out on March 23, 1919, near the shaft on the 4,000-ft. level of the Argonaut, that mine, as well as the Kennedy, adjoining, were temporarily sealed. When the fire

on April 9, 1922, by F. L. Lowell, who found that general safety conditions were good. A Federal and State investigation will be made and the findings will be published. Claim for compensation or court action must be instituted separately, thus leaving the investigation clear of all other procedure.

As we go to press two crews are driving toward the entombed men, a reward of \$5,000 having been offered for the first to break through. These are respectively on the 3,600 and 3,900 levels of the Kennedy mine. It is estimated that at least a week will be required to reach the Argonaut workings. Gases discharged from the Muldoon shaft indicate the dying out of the fire. Many maintain that the miners cannot possibly be alive, while others are just as positive in their contention that they survive. Final checking shows that forty-seven men are entombed.

UTAH

Utah Copper's Current Production Cost Said To Be 9c. per Pound

Eureka—Shipments for the week ended Sept. 3 amount to 147 cars. Shippers were: Chief Consolidated, 39 cars; Tintic Standard, 37; Iron Blossom, 13; Grand Central, 12; Colorado, 9; Eagle & Blue Bell, 7; Victoria, 5; Gemini, 5; Swansea, 4; Tintic Drain Tunnel, 4; Central Eureka, 4; Dragon, 3; American Star, 2; Bullion Beck Sioux, 1.

Park City—Shipments for the week ended Sept. 3 amount to 4,336 tons as compared with 4,111 tons the week preceding. Shippers were: Ontario, 1,393 tons; Park-Utah, 1,211 tons; Silver King Coalition, 888; Judge and Park City Mining & Smelting, 844. The Park City Mining & Smelting—a consolidation of the Daly West and the West Ontario—is securing the Judge property also, by exchange of stock. This will place an extensive and valuable property under one management, and make possible the most economical and advantageous development of the ground. There have been important new finds at both the Judge and Daly West, and the West Ontario, lying to the north of the Judge and Daly West, is entirely virgin ground, in a most promising situation. The Daly, although not a part of the Park City Mining & Smelting, is under the same management and is operated under agreement for handling ore.

Alta—The Alta Tunnel & Transportation Co., in Big Cottonwood canyon, according to a statement to stockholders, in a little less than a year has shipped 1,150 tons of ore of a gross value of \$54,305. Hauling and treatment costs were \$19,673 and royalties \$5,668, which left a net return of \$28,962. The grade of the ore in the last three shipments has been lower, but the ore at present being mined is said to show improvement. Shipments are being kept up, and work is being done in a number of places. An assessment of 1c. per share has been levied. This has been made necessary by poor mining facilities, which made ore extraction unduly slow and expensive. The assessment is being made to furnish money to meet the debts incurred and to expedite development in advance of ore extraction. Lower costs are expected to result.

Salt Lake City—Final figures by the Utah Copper Co. show costs during the second quarter of the year to have averaged 10½c. per pound of copper produced. Production amounted to 22,160,000 lb., almost 50 per cent of which was produced during the last month. In that month (June) production costs are understood to have been under 9c. per pound for the 9,500,000 lb. of copper produced, although this is not stated in the report.

American Fork—New ore is reported to have been opened by the American Leasing Co. working in Mary Ellen gulch.

NEVADA

Another Company Shows Interest in Middle Mines Group—New Vein Reported from Rochester

Comstock—The Comstock Merger Mines, Inc., a \$20,000,000 corporation, recently took over the Exchequer, Bullion, Chollar & Potosi, Hale & Norcross, Savage, Gould & Curry and the Best & Belcher claims, known as the Middle Mines group. The Nevada Canyon Mining Corporation, representing the same interests as the Comstock Merger Mines, Inc., took over the Rogers Silver Mining Co., Central Gold and Silver Mining Co., Opal Gold and Silver Mining Co., the J. B. mine, Berry group and the Lady Bryan and Pet claims. The latter company is in the Flowery District about two miles east of the Comstock. Gold is the principal valuable metal.

Eureka—The Eureka Croesus Mining Co. has closed the deal for the purchase of the Eureka and Nevada Railroad, the 88-mile narrow-gauge railroad between Palisade on the Southern Pacific and Eureka.

Goldfield—The Goldfield Development Co. property at Gold Hill, twenty miles southwest of Goldfield, has partially developed a large body of siliceous gold ore, which follows a limestone shale contact.

The Silver Pick lease on the Red Top continues on ore of a lower tenor; it is being sorted for shipment to Tonopah.

Rochester—The Rochester Silver Mines Co. has opened up a new flat dipping vein of fair mill ore on the 800-ft. level.

Royston—The original Betts lease has been taken over by the Canadian Leasing Co. It recently picked up the faulted segment of ore, which shows in lead and silver up to \$1,000 a ton.

Seven Troughs—The Seven Troughs Reorganized Mines Co. made a small shipment of bullion, the first in five years. Extensive development is planned to prove up the property at depth.

Tonopah—The Tonopah Mining Co. is reported to have purchased the Ajax mine at Cripple Creek, Col., for a consideration of \$200,000. The Tonopah Belmont Development Co. has declared a 5c dividend.

Divide—The Tonopah Divide Mining Co. made a net earning of approximately \$35,000 during the month of August.

Leasers on the Divide Extension Mining Co. have opened up three feet of shipping ore between the 100 and the 200 levels.

Ely—The Boston & Ely Con. Mining Co., under the management of Herbert Williams, is now putting in a spur track 900 ft. long, to connect with the Nevada Northern main line. This spur track will connect with the ore bins at the tunnel portal. A large tonnage of ore carrying from 7 to 10 per cent copper is developed in the mine. It is expected that the ore will be handled at McGill by the Nevada Consolidated.

COLORADO

Ore Shipments to Colorado Springs Increase

Cripple Creek—The Cripple Creek Shortline Railroad, which was built during the early days of the Cripple Creek boom, has been ordered sold by Judge Symes of the Federal Court in Denver. Service over the road has been abandoned for the past two years as diminishing business in the district did not justify the operation of more than one line into the gold camp. It is thought that the road will be junked and the roadbed converted into an automobile highway.

The Portland is getting out about five carloads of ore daily, all of which is going to the Golden Cycle mill at Colorado Springs. The grade of ore hoisted from the 2,600 level, the scene of the recent strike, is around 4 oz. with a value of \$3,000 per car.

The mines in the Cripple Creek district shipped 24,300 tons of ore from the Cripple Creek districts to the Golden Cycle mill at Colorado Springs during the month of August, an increase of 4,800 tons over July. The average value was \$15 with a gross value of \$364,500, an increase in value of \$72,000 over July.

IDAHO

Coeur d'Alene Companies Still Need Miners

Wallace—Engineers who will leave New York on Sept. 9 in private cars to attend the semi-annual meeting of the American Institute of Mining and Metallurgical Engineers in San Francisco will stop two days in the Coeur d'Alene district, Idaho, and arrangements for their entertainment and also for the ladies of the party have been made by local engineers under the leadership of Rush J. White, chairman of the Columbia Section of the Institute. The visitors will arrive at Kellogg on Sept. 18 and the afternoon will be spent either in the Bunker Hill & Sullivan mine or at the Bunker Hill smelter. A banquet will be served in their honor in the evening. Next morning the visitors will go to the Hecla mine at Burke and the Morning mine at Mullan. Luncheon will be served at the mine boarding houses. The engineers will leave at 2:30 in the afternoon for Spokane, where they will be guests at a dinner served in the Davenport.

The labor shortage still continues acute in the Coeur d'Alene district. Various explanations are offered, but the most plausible seems to be that when low metal prices forced many mines to close down following the war, the miners laid off scattered to the four winds and found employment in other lines of industry. Now that mining has revived and their old jobs are open, they find that from a purely financial standpoint they are doing just as well or better than they did in the mines. With no advantages offered by the mines in the way of cash, these men prefer to stick to employment on top rather than to return under ground.

OREGON

Bay Horse Mine Ships \$30 Ore

Huntington—Shipments from the Bay Horse mine to the end of August totaled 52 cars of ore averaging \$30 per ton. Practically all of this material was taken out in the course of development. Two winzes are now being started at some distance apart within the mineralized area, with a view to exploration on the downward extension of the ore bodies before deciding on deeper development by tunnel.

MINNESOTA

Ore Production Statistics Showing Expansion—Oliver Company Concludes Work at Genoa Mine

Nashwauk—Stripping operations have been started by the Wisconsin State Steel Co. at its Hawkins open pit. These operations will be increased on the arrival of new equipment which has been ordered.

Eveleth—The Oliver Iron Mining Co. has ceased all operations at the Genoa mine due to the expiration of its lease on Aug. 31. Drilling is being done at present by the fee owners with expectations of proving more ore. The mine is one of the oldest in the district, as it was explored in 1894 and mining operations started in 1896. The Oliver has shipped approximately 10,000,000 tons from the open pit and underground workings during its period of operation.

Chisholm—The Hanna Ore Mining Co. has announced the reopening of its Alexandria mine after a close down since April, 1921. This property is rapidly getting into shape to increase production, as the shaft has been deepened and the development work on the East forty is being pushed to an operating basis.

Hibbing—The electrification work at the Stevenson mine, operated by the McKinney Steel Co., is rapidly nearing completion. With the completion of this work, it is rumored, underground operations will be resumed with the employment of 200 men.

Following is a summary of the report of the inspector of mines for the county of St. Louis, Minn., covering a period of one year, from July 1, 1921, to June 30, 1922. It will be noted that only eighty-six mines were operated during this period, but since this period and up to the present date, many other properties have been opened and are now operating:

	1920	1921
Number of mines operated.....	86	102
Number of mines not operated.....	91	74
Total number of mines.....	177	176
Number of men employed underground.....	2,851	5,231
Number of men employed in open-pit mining.....	1,553	2,609
Number of men employed in stripping operation.....	1,962	2,203
Number of men employed on surface.....	1,512	2,000
Total number of men employed.....	7,878	12,043
Number of tons of ore shipped from underground.....	4,463,280	7,868,937
Number of tons of ore shipped from open pits.....	9,561,010	19,296,449
Total shipments.....	14,024,290	27,165,386
Number of cubic yards of stripping removed.....	14,122,586	12,590,997
Number of fatal accidents underground.....	13	11
Number of fatal accidents on surface.....	6	15
Number of fatal accidents per 1,000 men employed.....	2.41	2.15
Number of tons of ore shipped per fatal accident.....	738,120	1,044,822
Number of serious non-fatal accidents.....	17	33
Average wage.....	\$4,932	\$5.81

ARIZONA

Temporary Curtailment at Inspiration—Copper Queen Smelter Gets Nacozari Concentrate

BY JAMES H. McCLINTOCK

Jerome—Verde Inspiration, nine miles south of Jerome, is to have a 100-ton cyaniding mill, with fine grinding in a roller and tube mill. The gold is found in very fine and "greasy" condition and only 50 per cent of the assay value was secured in a 25-ton mill now on the ground, equipped with Wilfley tables. Installation of cyanide tanks already has been started under charge of W. W. Linesba, of San Francisco, vice-president of the operating company.

Prescott—About 400 men are now employed by the Southwest Metals Co. in its Humboldt smelter and in mining near by and at Swansea. Production of copper is expected to run about 1,000,000 lb. a month.

Rich gold-silver ores are being shipped to Humboldt from Crown King mines, especially from the Cougar, Gino, and Red Cross properties. The last is under lease to Frank W. Giroux, manager of the Swastika mine.

Wickenburg—There is local report of the sale of the famous old Vulture mine to J. H. McKnight & Co., a California firm. There is also rumor of building a 400-ton mill, though the mill of the McKay regime was junked only last year.

The Diamond Joe mine in White Picacho district, east of here, has been sold for \$50,000 by G. R. Koyk and John Boetta, of Wickenburg, to a company represented by George L. Felt.

Globe—For a while recently three of the fourteen operating sections of the Inspiration mill had to be shut down. Ore deliveries from the main shaft were stopped by a bulging of the concrete on the 400 level, that put the skips and hoist out of operation.

Douglas—The Copper Queen smelter here is now handling about 10 carloads of concentrate a day from the Nacozari mill; these run from 16 to 18 per cent copper.

At the instance of the Phelps Dodge Corporation, a petition has been filed in Tombstone asking dissolution of the Morenci Southern Railway Co., which formerly connected Morenci with the Arizona & New Mexico railway at Guthrie. Morenci now is reached by rail over the Shannon railway from Clifton.

MICHIGAN

The Copper Country

Copper Shipments Maintained—Seneca Will Start New Shaft Oct. 1

Houghton—Copper shipments from the Michigan region in August were fully as large as predicted, 10,602,000 lb. going forward. July shipments were 10,734,000 lb. In August a year ago the total was only 5,176,000. Approximately half of last month's shipments was from the Calumet & Hecla smelter. France was the largest foreign buyer of Lake metal in August and between 30 and 40 per cent of the Calumet & Hecla shipments was export copper. Demand from the automotive centers shows no falling off, with Detroit the best customer. September orders from this source continue brisk. Metal stocks now at the smelters are no larger than carried in normal years.

Progress is being made in the erection of the reclamation plant at the Tamarack conglomerate sands on Torch Lake. Steel work is going up for the leaching and flotation buildings and excavating for the shore plant is under way. The dredge, which will scoop the sand out of the lake, will be built in Calumet & Hecla's own drydock. It probably will be the spring of 1924 before the entire project is completed. The plant will be a duplicate of the Calumet & Hecla plant in all but size, its capacity to be approximately half.

Seneca will start sinking in Gratiot No. 2 shaft about Oct. 1. Work on installation of boilers and hoist will be completed this month if the rail strike does not interfere with delivery of material and equipment. It is a two-drum hoist of six-ton capacity and will easily carry the shaft down 2,000 ft. more from the 13th level to a depth of 3,200 ft., at which point connection will be made with the 3rd level drift from the Seneca shaft. No. 2 has been practically rebuilt from surface to the bottom level and is now thoroughly modern in every respect. It is planned to sink approximately 130 ft. a month so the objective should be reached in 15 or 16 months. Levels will be established every 200 ft. and the new bottom level will be the 24th. The 13th level, south, extends to the Mohawk boundary, a distance of 1,064 ft., in commercial ground all the way. Two raises were put in here to the 11th level and the 11th is now being driven south toward Mohawk to intersect these raises. The 9th, 7th and other upper Gratiot levels are to be driven south to the boundary.

Menominee Range

Iron River—Sinking is progressing at the Spies mine of the Cleveland-Cliffs Iron Co. No mining is being done. A diamond drill, one of the few now operating in the district, is at work on surface. The operators and fee owners of the Homer mine are again in litigation. The owners maintain that the ore is not being properly mined, that sand is allowed to mix, which brings a penalty in the market.

THE MARKET REPORT

Daily Prices of Metals

Sept.	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
7	13.75	32.00	32.375	5.90	5.60	6.25
8	13.75	32.00	32.25	5.90	5.60@5.625	6.25
9	13.75	32.00	32.25	5.90	5.625	6.25@6.30
11	13.75	31.875	32.25	5.90	5.625	6.30@6.35
12	13.75	31.875	32.25	5.90	5.625	6.325@6.375
13	13.75	31.875	32.25	5.90	5.625	6.35@6.40

*These prices correspond to the following quotations for copper delivered: Sept. 7 to 13 inc., 14c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Sept.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3 M							
7	63 $\frac{1}{2}$	63 $\frac{1}{2}$	70 $\frac{1}{2}$	159 $\frac{3}{4}$	160 $\frac{1}{2}$	24 $\frac{1}{2}$	23 $\frac{1}{2}$	31 $\frac{3}{4}$	30 $\frac{3}{4}$
8	63 $\frac{1}{2}$	63 $\frac{1}{2}$	70 $\frac{1}{2}$	159 $\frac{3}{4}$	160 $\frac{1}{2}$	24 $\frac{1}{2}$	23 $\frac{1}{2}$	31 $\frac{3}{4}$	30 $\frac{3}{4}$
11	63	63 $\frac{1}{2}$	70 $\frac{1}{2}$	159 $\frac{1}{2}$	159 $\frac{1}{2}$	24 $\frac{1}{2}$	23 $\frac{1}{2}$	31 $\frac{1}{2}$	30 $\frac{3}{4}$
12	63 $\frac{1}{2}$	63 $\frac{1}{2}$	70 $\frac{1}{2}$	158 $\frac{3}{4}$	159 $\frac{1}{2}$	24 $\frac{1}{2}$	23 $\frac{3}{4}$	31 $\frac{1}{2}$	30 $\frac{3}{4}$
13	63 $\frac{1}{2}$	63 $\frac{1}{2}$	71	159 $\frac{1}{2}$	160 $\frac{1}{2}$	24	23 $\frac{1}{2}$	31 $\frac{1}{2}$	30 $\frac{3}{4}$

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Sept.	Sterling Exchange "Checks"	Silver			Sept.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
7	4.46	99 $\frac{1}{2}$	70 $\frac{1}{2}$	35 $\frac{1}{2}$	11	4.45	99 $\frac{1}{2}$	69 $\frac{1}{2}$	35 $\frac{1}{2}$
8	4.45 $\frac{1}{2}$	99 $\frac{1}{2}$	69 $\frac{1}{2}$	35 $\frac{1}{2}$	12	4.44 $\frac{1}{2}$	99 $\frac{1}{2}$	69 $\frac{1}{2}$	35 $\frac{1}{2}$
9	4.45 $\frac{1}{2}$	99 $\frac{1}{2}$	69 $\frac{1}{2}$	35 $\frac{1}{2}$	13	4.43 $\frac{1}{2}$	99 $\frac{1}{2}$	69 $\frac{1}{2}$	35 $\frac{1}{2}$

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Sept. 13, 1922

The market was most active in copper and zinc during the week, although the sales of lead were by no means unsatisfactory. The freight embargo has caused some producers considerable trouble, but others have been so fortunate as to be situated on roads unaffected by that difficulty. One of the notable price changes in the week has been the advance in antimony. Many of the minor metals are greatly influenced by prospective high tariffs and have shown increased prices. Quick-silver, antimony, and arsenic are other

commodities that have reflected the tariff in their prices.

Transatlantic freight rates remain substantially unchanged from our last report. To most ports the rate is \$4 per long ton, though \$3.50 might be done to Rotterdam and Antwerp. Transpacific rates to Hongkong and Kobe are \$5.

Copper

It is seldom that one finds the unanimity in price among copper producers that prevailed last week. Both the smallest and the largest producers sold copper during the week at 14c. delivered. No sales were reported at higher levels, and although the 14c.

price was shaded in two sales it was only because the delivery point provided for a low freight rate. There is no disposition to either cut or advance prices at the present moment, and the market is as firm on a 14c. basis as it can hope to be. Domestic business on the whole has been better during the past week than for the week previous. Foreign sales have been made in fair volume at prices netting close to the domestic market. The stability of copper is viewed with satisfaction by consumers, who have been able to make plans easier than with a fluctuating market. Although one producer has attempted to interest consumers in metal for delivery as late as next March, his efforts have been unsuccessful, despite the fact that his quotation appreciably shaded the spot price.

Lead

The official contract price of the American Smelting & Refining Co. continues at 5.90c. New York.

Sales of lead have not been as heavy in the past week as for the latter part of August, owing principally to the reluctance of the chief producers to make quotations. One producer is entirely out of the market for September shipment and is quoting 5.80c. St. Louis for October. Paint, alloy, pipe, storage-battery manufacturers, railroads, steel companies and locomotive works have all been in the market. The center of activity was the St. Louis market, that in New York remaining at 5.90c. In the Middle West the market is higher and firm at its present level. Last Thursday and Friday sales were made at 5.60 and 5.625c. in fairly large tonnages. On Monday and today sales were made at 5.625c. The European market is very strong, and there is no weak spot in lead's excellent position.

Zinc

The metal has advanced in price in an active market. The statistics of the American Zinc Institute show that for the month of August stocks were reduced 7,000 tons. Stock on hand Aug. 1, 1922, was 28,618 tons; production for August was 31,423; shipments were 38,412, and stock on hand Aug. 31 was 21,629 tons. A serious shortage of zinc is imminent if consumption keeps up its present rate and production shows no signs of increasing. Last Thursday and earlier in the week sales were made for 6.25c., whereas today the general asking price is 6.40c. for prompt shipment. Metal for delivery in November and December was available during the last few days at reductions of 5 points from the spot price. High-grade zinc was sold in satisfactory volume during the week for 7.25c. per lb.

Tin

The market showed unusual activity on Tuesday, attributed partly to the increased interest by buyers in the expectation that prices were due for a rise. The shortage of spot 99 per cent metal continues. The American Smelting & Refining Co. will not produce any electrolytic tin this month, but will resume operations in October.

Arrivals of tin, in long tons: Sept. 1st, China, 125; 5th, China, 25; Straits, 240; 7th, Java, 105; Straits, 50; London, 50; 8th, Java, 125; Straits, 5; 12th, China, 75.

Gold

Gold in London: Sept. 7th, 92s. 4d.; 8th, 92s. 5d.; 11th, 92s. 6d.; 12th, 92s. 6d.; 13th, 92s. 9d.

Stock of money in the United States Aug. 1: Gold coin and bullion, \$3,824,843,419; standard silver dollars, \$384,776,851; subsidiary silver, \$271,050,201; United States notes, \$346,681,016; Federal Reserve notes, \$2,566,380,060; Federal Reserve Bank notes, \$75,866,400; National Bank notes, \$758,071,562; total, \$8,227,669,509. Money in circulation per capita, \$39.47. The gold stock increased by \$39,000,000 during the preceding month.

Foreign Exchange

Exchanges have shown weaker tendencies in the last week. On Tuesday, Sept. 12, francs were 7.655c.; lire, 4.27c.; marks, 0.055c.; and Canadian dollars, 1/2 per cent discount.

Silver

The silver market has been quiet throughout the week, and although London has remained steady, the New York price has declined, owing to the weakness in sterling exchange. The Indian rupee rate has fluctuated only slightly, although China exchanges have shown an easier tendency.

Mexican Dollars—Sept. 7th, 53½; 8th, 53½; 9th, 53½; 11th, 53½; 12th, 53½; 13th, 53½c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—Contract prices by principal interest: 99 per cent, 20.1c. per lb.; 98@99, 19.1c.; 94@98, 18c. Odd lots for spot delivery, 98@99 per cent, have been selling as low as 17.75c.

Antimony—Chinese and Japanese brands, 6@6.50c. W.C.C., 6.75@7c. Cookson's "C" grade, 7@7.50c. Market is very active. No metal has been offered for shipment from China in two weeks. The effect of a high tariff is also being discounted in the advance. Demand from large consumers has been good.

Bismuth—\$2@2.10 per lb.

Cadmium—\$1.20@1.25 per lb.

Iridium—\$275@300. Nominal.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market, 32@34c. per lb.

Palladium—\$55 per oz.

Platinum—\$118 per oz. Strong.

Quicksilver—\$65@67 per 75-lb. flask. Market good. San Francisco wires \$63.70.

Selenium—\$1.80@1.90 per lb.

Tellurium—\$2 per lb.

The prices of Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Rhodium, Thallium, and Tungsten are unchanged from prices given Sept. 2.

Metallic Ores

Chrome Ore—Indian chrome ore, \$18 per ton, c.i.f. Atlantic ports. Rhodesian and New Caledonian, \$23 and \$25 per ton. Market quiet.

Manganese Ore—29c. per long ton unit, seaport.

Molybdenum Ore—48@50c. per lb. of MoS₂ for 85 per cent MoS₂ concentrates.

Tungsten Ore—Chinese ore, \$5 per long ton unit of WO₃.

Iron Ore, Magnetite, Tantalum, Titanium, Uranium, Vanadium, and Zircon ore are unchanged from the quotations published Sept. 2.

Zinc and Lead Ore Markets

Joplin, Mo., Sept. 9—Zinc blende, per ton, high \$39.90; basis 60 per cent zinc, premium, \$37@38; Prime Western, \$36@37; fines and slimes \$35@33; average settling price, all grades of blende, \$36.28; calamine, basis 40 per cent zinc, \$20@21.

Lead, high \$84.90; basis 80 per cent lead, \$80@81.50; average settling price, all grades of lead, \$80.31 per ton.

Shipments the week: Blende, 8,138; calamine, 38; lead, 1,412 tons. Value, all ores the week, \$417,580.

The car situation was more acute than any previous week, but all cannot be charged against the strike, as it is grain moving season. In August, production averaged 9,253 tons, purchases, 8,872 tons, and shipments, 7,460 tons. In eight months production averaged 9,253, purchases, 8,618, and shipments, 8,875 tons. August shipments averaged 1,415 tons lower than the average of the eight months, and compares favorably with the same month in previous years.

Platteville, Wis., Sept. 9—Blende, basis 60 per cent zinc, \$38 per ton; lead, basis 80 per cent lead, \$81 per ton. Shipments for the week, 754 tons of blende and no lead. Shipments for the year: Blende 13,537; lead 1,204 tons. Shipped during the week to separating plants, 852 tons blende.

Non-Metallic Minerals

Feldspar—No. 1 pottery, \$7@7.50 per gross ton, f.o.b. North Carolina points. Market fair.

Magnesite—\$15 per ton for crude, \$35@37.50 for calcined magnesite, f.o.b. California points. Northwest American magnesite industry has been shut down for the last year.

Talc—200 mesh, \$15; 300 mesh, \$18.50 per ton, f.o.b. California points.

Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, and Sulphur are unchanged from the prices published Sept. 2.

Mineral Products

Arsenious Oxide (white arsenic)—8.50@9c. per lb.

Copper Sulphate—Large crystals, 6.50c. per lb.

Sodium Nitrate—\$2.25@2.65 per 100 lb., ex vessel Atlantic ports.

Potassium Sulphate and Sodium Sulphate are unchanged from quotations of Sept. 2.

Ferro-Alloys

Ferrocerium, Ferrocrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium, and Ferrovandium are unchanged from the prices published Sept. 2.

Metal Products

Copper Sheets—New York base, 21.50c. per lb.; wire, 15.50@15.75c. net.

Nickel Silver—29c. per lb., for 18 per cent nickel Grade "A" sheets.

Yellow Metal—Dimension sheets, 19.25c.; rods, 16.25c. per lb.

Zinc Sheets—Base price, \$8 per 100 lb., f.o.b. Illinois points, with discounts for cash and quantity.

Lead Sheets—Full lead sheets, 8.75c.; cut lead sheets, 9c. in quantity, mill lots.

Refractories

Magnesite Brick—\$56 per net ton.

Magnesite Cement—\$35@40 per ton.

Silica Brick—\$38@41 per 1,000, f.o.b. shipping points.

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, and Zirkite are unchanged from the prices appearing in the issue of Sept. 2.

The Iron Trade**Pittsburgh, Sept. 12, 1922**

Production of steel ingots in August was at an average rate of about 30,000,000 tons a year, against rates of 36,000,000 tons in July and 36,600,000 tons in June, the high month of the year. Production decreased sharply from the middle of July to approximately the end of August, when the rate was hardly above 26,000,000 tons, or 50 per cent of capacity.

The Steel Corporation's unfilled tonnage at the end of August was 5,950,105 tons, the largest order book since early in April, 1921.

Greater premiums are being paid for early deliveries of sheets, the range on common black, for various deliveries, being 3.35@3.75c. Bars are 1.90@2.25c., shapes 2@2.25c., and plates 2@2.50c. Rivets are up \$7 a ton to 3c. for structural and 3.10c. for boiler rivets.

Pig Iron—The market remains one of spot and prompt deliveries only, no extended deliveries being negotiable as idle furnaces do not know when they can start, coke supplies for merchant furnaces not being improved. Bessemer remains at \$34, Valley. Basic is nominal at \$30, Valley, with offerings at considerably higher prices.

Connellsville Coke—Furnace coke, \$11@11.50, with very meager offerings; foundry, \$12.50@13.

Germany Reorganizing Her Aluminum Industry

Special foreign correspondence

Charlottenburg, Aug. 19.—The German aluminum industry is of recent growth. Before the World War only one branch of the Swiss firm, the Aluminum Industry Neuhausen, at Rheinfelden (Bade), existed. It had a capacity of 800 metric tons annually, while rolling of aluminum to sheets and its manufacturing to hollow ware were confined to the plants of Carl Berg in Westphalia. But as Germany was cut off from raw-stuff sources early in the war, its war ministry devised large plans to replace the expensive foreign metals, such as copper, tin, nickel, and antimony, by more available materials. It so happened that in the occupied fields of the Balkan countries, in Dalmatia and East Hungary, there were large deposits of clay and bauxite. On these the war authorities founded a system of aluminum production on a large scale. The plant of Rummelsburg was established by the end of the year 1915 under the collaboration of Metallbank and Metallurgische Gesellschaft at Frankfort-on-Main and the Chemische Fabrik Griesheim-Elektron. This plant, with a productive capacity of 3,500 tons, had to be closed by the end of the war on account of unduly high costs of production.

A somewhat longer life (until 1920) was enjoyed by the plant at Horrem, near Cologne, which derived its electrical current from lignite, with the same capacity, and by the works at Bitterfeld, to which the above mentioned firm, Griesheim-Elektron, furnished the necessary power for producing about 4,000 tons a year. The ones that survived, however, are now first the Erftwerk, near Grevenbroich, which was established in August, 1916, and operated from December, 1917. The current it uses is supplied from cheap power stations of the Cologne district, where electric power is generated by lignite combustion, at 100,000 v. The second aluminum plant of Germany today is the Lautawerk, near Hoyerswerda, likewise built in the years 1917 and 1918 on abundant lignite power in its vicinity. The so-called Innwerk, built to utilize the large waterpower of the Alps, which is being established now by the A.E.G. (Allgemeine Elektrizitäts-Gesellschaft), Siemens-Schuckert, the Brothers Giuliani, under collaboration of the authorities, bids fair to become the best aluminum plant of the country.

The aggregate annual capacity of Germany may be roughly computed at 130,000 tons of refined aluminum or somewhat more. As a matter of fact, only 15,000 to 20,000 tons are produced. The hasty manner in which, by war contingencies, the German aluminum refineries have been called into life, with little regard being given to cost and competition, has more than once threatened to cut their life-threads in the three years since the armistice, especially in the spring and summer of 1921, when copper was cheap in America and the dollar rate nearer to its pre-war parity. But the exchange drama has, by its general and economical consequences and money stringency, given a fillip to the use of aluminum instead of the foreign red metal. A large amount of research work in all private and public laboratories is endeavoring to replace copper in a great many ways by the light, German "home-made" metal. Space forbids describing here the numerous most interesting alloying undertakings, which have proved successful. A noteworthy example has been the alloy Duraluminium. Unluckily, fuel and labor difficulties at present are handicapping the further decided progress of science in that direction. Moreover, the general prospect of the plants is somewhat clouded by the fact that the supply of bauxite is beginning to become rather scarce.

There are many rumors which argue that this is the very reason why the clever Mr. Stinnes, the former owner of the Erftwerk, has sold it to the state. As a matter of fact, the whole aluminum refining industry of Germany is now state-owned, but managed, however, on commercial lines. In order to spare bauxite and clay, the remelting of aluminum scrap and residue has become customary with a great many rolling mills. This is the reason why, so aluminum people here insist, importers on the other side of the Atlantic are complaining of blisters and buckles in certain recent sheets shipments. The electrolytically refined virgin metal is,

naturally, excellently prepared and of best quality. A noteworthy fact is the dealing in aluminum on a mark basis, while with other metals, even with zinc, business here goes on mostly on dollar and pound currency basis; as regards copper, gold, and lead, on a pound and guilders basis; as regards tin, antimony, or silver, on the franc. This has arisen from the vagaries of the mark.

Movements of Ores and Metals in July

The imports and exports of the principal ores and metals to and from the United States as reported by the Bureau of Foreign and Domestic Commerce for July, 1921 and 1922, follow:

IMPORTS, JULY, 1921 AND 1922
In pounds, unless otherwise stated

	July, 1921	July, 1922
Antimony matte, regulus or metal.....	2,141,640	3,634,190
Copper:		
Ore, contents.....	5,345,020	10,160,583
Concentrates, contents.....	2,997,406	574,865
Matte, regulus, etc., contents.....	2,582,547	198,892
Imported from (in part):		
Spain.....	263,200	1,084,057
Canada.....	188,178	269,421
Chile.....	6,286,021	9,144,373
Peru.....	57,930	276,110
Unrefined, black, blister, etc.....	20,749,969	25,656,776
Refined, in bars, plates, etc.....	1,530	6,636,860
Old, etc., for remanufacture.....	594,305	591,521
Composition metal, copper chief value.....		1,938
Lead:		
Ore, contents.....	268,524	116,167
Bullion, contents.....	3,065,824	9,372,231
Imported from (in part):		
Canada.....		2,674
Mexico.....	3,207,541	9,372,231
Chile.....	48,649	20,481
Pigs, bars and old.....	1,605,953	1,539,422
Manganese, ore, long tons.....	5,028	62,518
Tungsten ore, long tons.....	47	704
Pyrites, long tons.....	19,973	31,040
Imported from:		
Spain, long tons.....	19,973	31,040
Tin ore, long tons.....	885	1,604
Tin bars, blocks, pigs, etc.....	3,565,767	12,683,135
Imported from (in part):		
United Kingdom.....	1,058,406	1,465,091
British Straits Settlements.....	2,432,058	10,069,625
Dutch East Indies.....		391,683
Hongkong.....	22,400	566,255
Zinc:		
Ore, contents.....		746,358
Blocks, or pigs, and old.....		1,457

EXPORTS OF COPPER, LEAD AND ZINC
In pounds

	July, 1921	July, 1922
Copper:		
Matte and regulus (copper content).....		300
Copper and manufactures of (total).....		64,430,580
Unrefined, black, blister, etc.....		58,511,062
Refined, in ingots, bars, etc.....	47,323,870	
Exported to:		
Belgium.....	2,656,319	1,935,410
France.....	4,710,404	16,874,863
Germany.....	23,687,772	16,738,698
Italy.....	1,258,130	1,982,729
Netherlands.....	2,591,011	3,888,195
Spain.....	638,996	225,491
Sweden.....	695,244	1,618,392
United Kingdom.....	1,597,074	5,711,535
Canada.....	524,647	142,346
China.....		6,384,004
Japan.....	6,497,528	2,687,980
Other countries.....	2,466,745	321,419
Old and scrap.....	342	96,205
Composition metal, copper chief value.....	805	8,865
Pipes and tubes.....	114,670	122,745
Plates and sheets.....	191,647	261,531
Wire, except insulated.....	381,170	762,791
Insulated wire and cable.....		717,601
Lead:		
Pigs, bars, etc.:		
From domestic ore.....	52,703	1,549,553
From foreign ore.....	3,562,918	3,646,124
Exported to:		
France.....		1,848,773
Germany.....		448,221
Netherlands.....		
United Kingdom.....	3,002,911	2,468,415
Argentina.....		
Brazil.....	112,007	291,270
Japan.....	448,000	
Other countries.....	52,703	138,998
Zinc:		
Ore and concentrates (tons).....		175
Dross.....		617,777
Spelter:		
From domestic ore.....	73,508	8,644,335
From foreign ore.....	356,000	
Exported to:		
France.....		1,915,341
United Kingdom.....		4,539,600
Canada.....	137,785	6,010
Japan.....	280,024	562,311
Other countries.....	11,694	1,621,073
In sheets, strips, etc.....	191,758	493,147
Zinc dust.....		332,887
Other zinc manufactures.....		68,779

COMPANY REPORTS

Nevada Consolidated Copper Co.

A statement of the affairs of Nevada Consolidated Copper Co. for the second quarter of 1922 says that, after a shut-down and complete suspension of production for one year, operations were resumed in April, when a small tonnage of ore was mined from the Ruth mine, and in May steam-shovel operations were resumed in the Pits mine. The concentrator was placed in operation during the last of April, and the first blister copper was produced in the smelter about May 15.

The following table shows the net output by months:

	Pounds
April	2,145,892
May	5,103,277
June	4,286,741
Total	11,535,910

A total of 345,181 dry tons of Nevada Consolidated ore, averaging 1.612 per cent copper, was milled, and 29,758 dry tons of Ruth mine direct-smelting ore, averaging 6.35 per cent copper, was received at the smelter. In addition to the company ores received, 46 dry tons of custom ore, averaging 47.2 oz. silver, was purchased and smelted.

The cost of production per pound of copper for the quarter, including all fixed and general overhead expenses, other than federal taxes, and including also the exceptional expenses in all departments of the mines, mill, and smelter incident to the resumption of operations, was 14.10c. per lb. This cost does not include credit for gold and silver values, which for the quarter amounted to 0.06c. per lb. of copper.

The average carrying price of copper for the quarter was 13.209c. per lb., resulting in the financial outcome of operations as follows:

Operating loss	\$103,308.75
Shutdown expenses and miscellaneous non-operating costs	130,910.07
	\$234,218.82
Miscellaneous earnings and value of gold and silver ..	89,803.88
Decrease in surplus account	\$144,414.94

The patent litigation in which the company was involved with Minerals Separation has been satisfactorily settled out of court, and a favorable agreement has been entered into with Minerals Separation North American Corporation covering license for the future use of its flotation processes.

The main concentrator building was almost totally destroyed late in the afternoon of July 9 by a fire of unknown cause, which started near the south end of the crushed-ore storage bins adjoining the fine-grinding department.

Immediately following the fire, contracts were made for structural steel to replace two units. These will contain grinding and concentrating capacity of 8,000 to 9,000 tons per day. The old wooden storage bins will be replaced with steel construction, and the new plant will contain no wood at all except in apparatus where the employment of wood is necessary. At the time of writing this report, building steel for the first unit had all been shipped from the fabricating shops, and several carloads had arrived at the plant. Erecting equipment and crews were also on the ground, and, barring unforeseen delays, the first unit building will be completely erected by or before the first of October and the second one finished by or near the end of that month. By using the undamaged grinding machinery and such spares in the way of other apparatus as were on the ground, together with a considerable amount of machinery borrowed from the Utah Copper Co. plants at Garfield, it was estimated that the concentrating operations would be resumed to the extent of about 1,000 tons per day on Sept. 15. An

additional thousand tons of concentrating capacity will be available for use on Oct. 1, and thereafter added equipment will be put in operation weekly, to the end that the entire two units should be available for use by about the end of the year, dependent upon deliveries of new equipment as well as upon the demand for production.

In the meantime, copper output is being maintained at the rate of about 2,500,000 lb., and possibly somewhat more, per month through the treatment of increased quantities of ore drawn from the high-grade deposits of the Ruth mine, together with the small stock of concentrates and other smeltable material on hand. Upon resumption of concentrating operation to the extent of 2,000 tons per day by or before Oct. 1, production will be immediately restored to the curtailed rate prevailing prior to the fire.

Santa Gertrudis Co., Ltd.

Gold; Mexico

The general manager's report on the working operations of the Santa Gertrudis Co., Ltd., for the quarter from April 1 to June 30, 1922, follows:

The mill, during the above period, crushed 35,366 dry short tons of ore from the Santa Gertrudis mine. The value of the bullion produced was \$306,624.33 in United States currency. Working expenses (including development and shipping and selling) amounted to \$227,122.94, leaving an estimated profit at mines of \$79,501.39. In addition to the above tonnage, the mill crushed 73,544 dry short tons of ore delivered by the Inversiones Co. from its El Bordo, Malinche, and El Cristo mines.

Due to the sustained higher silver price, production was increased in June to 82 per cent of full capacity, as compared to the 70 per cent rate in effect for the last several months.

The price of silver was taken at \$0.6343 per fine ounce. The figure quoted for value of bullion produced is subject to correction, as the prices realized by actual sales are higher or lower than that taken.

The El Bordo groups produced 73,544 dry short tons of ore, of which 51,937 tons came from the El Bordo mine, 18,515 tons from El Cristo, and 3,092 tons from Malinche. All this ore was shipped to the mill of the Compania Beneficiadora de Pachuca, S.A., for treatment. The excess of revenue over expenditure, on the treatment of this ore, amounted to \$92,437. This figure is subject to the proportion accruing to the owners of the El Bordo properties.

It was largely on the expectation of what might be found in the Malinche mine, where the Vizcaina vein would be intersected, that the interest in the El Bordo was originally acquired. The developments on this vein appear to confirm this expectation and may have an important bearing on the future. It is characteristic of this vein, which is one of the most important in the district and has produced large bodies of high-grade ore on adjoining properties, that it is not ore-bearing above a depth of 1,200 to 1,300 ft., but below this ore shoots have persisted to depths of over 2,000 ft.

Chief Consolidated Mining Co.

Silver, lead; Utah

A report of the operations of the Chief Consolidated Mining Co. for the second quarter of 1922 shows that gross receipts from sales of ore in 1922 were \$1,730,029.45; operating cost, exclusive of depletion, \$1,348,468.72; net earnings, \$381,560.73; interest on investments, \$13,274.99; dividends, \$88,402.20. Surplus Jan. 1, 1922, was \$1,827,623.93, and on June 30, 1922, \$2,134,066.45.

MINING STOCKS

Week Ended Sept. 9, 1922

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Ahmeek.....	Boston	64	64	64	Aug. '22, Q \$1.00
Alaska-Br. Col. new.	N. Y. Curb	3	3	3	.....
Allouez.....	Boston	25	25	25	Mar. '19 1.00
Anaconda.....	New York	56	54	55	Nov. '20, Q 1.00
Arcadian Consol.....	Boston	2	2	2	.....
Ariz. Com'l.....	Boston	9	8	9	Oct. '18, Q 0.50
Big Ledge.....	N. Y. Curb	*10	*8	*9	.....
Bingham Mines.....	Boston	18	16	18	Sept. '19, Q 0.25
Calumet & Arizona.....	Boston	63	62	62	June '22, Q 0.50
Calumet & Hecla.....	Boston	305	296	296	Aug. '22, Q 5.00
Canada Copper.....	N. Y. Curb	*6	*4	*4	.....
Centennial.....	Boston	9	9	9	Dec. '18, SA 1.00
Cerro de Pasco.....	New York	41	40	40	Mar. '21, Q 0.50
Chile Copper.....	New York	24	23	24	.....
Chino.....	New York	31	30	30	Sept. '20, Q 0.37
Con. Copper Mines.....	N. Y. Curb	*25	*25	*25	.....
Copper Range.....	Boston	43	43	43	Mar. '22, Q 1.00
Crystal Copper.....	Boston Curb	1	1	1	.....
Davis-Daly.....	Boston	6	5	5	Mar. '20, Q 0.25
East Butte.....	Boston	10	10	10	Dec. '19, A 0.50
First National.....	Boston Curb	*63	*60	*60	Feb. '19, SA 0.15
Franklin.....	Boston	2	2	2	.....
Gadsden Copper.....	Boston Curb	*85	*81	*85	.....
Granby Consol.....	New York	32	31	32	May '19, Q 1.25
Greene-Cananea.....	New York	33	32	32	Nov. '20, Q 0.50
Hancock.....	Boston	2	2	2	.....
Howe Sound.....	N. Y. Curb	3	3	3	Jan. '21, Q 0.05
Inspiration Consol.....	New York	42	41	42	Oct. '20, Q 1.00
Iron Cap.....	Boston Curb	6	6	6	Sep. '20, K 0.25
Isle Royale.....	Boston	†24	†23	23	Aug. '22, Q 0.50
Kennecott.....	New York	38	37	37	Dec. '20, Q 0.50
Keweenaw.....	Boston	2	2	2	.....
Lake Copper.....	Boston	4	4	4	.....
La Salle.....	Boston	3	3	3	.....
Magma Copper.....	N. Y. Curb	32	29	32	Jan. '19, Q 0.50
Majestic.....	Boston Curb	†110	†95	98	.....
Mason Valley.....	N. Y. Curb	1	1	1	.....
Mass. Consolidated.....	Boston	2	2	2	Nov. '17, Q 1.00
Miami Copper.....	New York	30	29	29	Aug. '22, Q 0.50
Michigan.....	Boston	3	2	2	.....
Mohawk.....	Boston	63	62	62	July '22, Q 1.00
Mother Lode Coa.....	N. Y. Curb	11	11	11	June '22, I 0.50
Nevada Consol.....	New York	17	17	17	Sept. '20, Q 0.25
New Cornelia.....	Boston	19	18	18	Aug. '22, K 0.25
North Butte.....	Boston	12	12	12	Oct. '18, Q 0.25
Ohio Copper.....	N. Y. Curb	*16	*11	*11	.....
Old Dominion.....	Boston	24	24	24	Dec. '18, Q 1.00
Oceola.....	Boston	37	35	35	Aug. '22, Q 1.00
Phelps Dodge.....	Open Mar.	†170	†160	.....	July '22, Q 1.00
Quincy.....	Boston	44	43	43	Mar. '20, Q 1.00
Ray Consolidated.....	New York	16	16	16	Dec. '20, Q 0.25
Ray Hercules.....	N. Y. Curb	2	2	2	.....
St. Mary's Min. Ld.....	Boston	47	45	45	Apr. '22, K 2.00
Seneca Copper.....	Boston	12	12	12	.....
Shannon.....	Boston	90	80	90	Nov. '17, Q 0.25
Shattuck Arizona.....	New York	9	8	9	Jan. '20, Q 0.25
South Lake.....	Boston	†1	†75	1	.....
Superior & Boston.....	Boston	1	1	1	.....
Tenn. C. & C. cfs.....	New York	10	10	10	May '18, I 1.00
Tuolumne.....	Boston	*70	*69	*70	May '13, Q 0.10
United Verde Ex.....	Boston Curb	29	28	29	Aug. '22, Q 0.25
Utah Consol.....	Boston	3	2	3	Sept. '18, Q 0.25
Utah Copper.....	New York	71	69	70	June '22, Q 0.50
Utah Metal & T.....	Boston	1	1	1	Dec. '17, Q 0.30
Victoria.....	Boston	1	1	1	.....
Winona.....	Boston	1	1	1	.....
Wolverine.....	Boston	10	10	10	.....

NICKEL-COPPER					
Internat. Nickel.....	New York	18	17	17	Mar. '19, Q 0.50
Internat. Nickel, pfd	New York	82	82	82	Aug. '22, Q 1.50
LEAD					
National Lead.....	New York	109	105	108	June '22, Q 1.50
National Lead, pfd...	New York	115	115	115	June '22, Q 1.75
St. Joseph Lead.....	New York	15	15	15	June '22, Q 0.25
QUICKSILVER					
New Idria.....	Boston	*20	*10	*15	.....
ZINC					
Am. Z. L. & S.....	New York	18	17	18	May '20, Q 1.00
Am. Z. L. & S. pfd...	New York	46	45	45	Nov. '20, Q 1.50
Butte C. & Z.....	New York	7	6	7	June '18, Q 0.50
Butte & Superior.....	New York	30	30	30	Sept. '20, Q 1.25
Callahan Zn-Ld.....	New York	10	8	10	Dec. '20, Q 0.50
New Jersey Zn.....	N. Y. Curb	154	154	154	Aug. '22, Q 2.00
Yellow Pine.....	Los Angeles	*50	*50	*50	Sept. '20, Q 0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial. X, Includes extra.
 Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.
GOLD					
Alaska Gold.....	New York	1	1	1	.....
Alaska Juneau.....	New York	1	1	1	.....
Atlas.....	Toronto	*30	*25	*29	.....
Carson Hill.....	Boston	9	8	8	.....
Cresson Consol. G.....	N. Y. Curb	2	2	2	July '22, Q, X \$0.10
Dome Mines.....	New York	39	38	39	July '22, Q .50
Florence Goldfield.....	N. Y. Curb	*21	*20	*21	.....
Golden Cycle.....	Colo. Springs	*98	*92	*92	June '21, Q 0.02
Goldfield Consol.....	N. Y. Curb	*21	*20	*21	Dec. '19, Q 0.05
Hollinger Consol.....	Toronto	13.40	12.60	13.40	Sept. '22, Q 0.05
Homestake Mining.....	New York	73	73	73	Aug. '22, M 0.25
Keora.....	Toronto	*11	*10	*11	.....
Kirkland Lake.....	Toronto	*47	*45	*47	.....
Lake Shore.....	Toronto	3.00	2.77	2.97	Aug. '22, Q 0.02
McIntyre-Porcupine.....	Toronto	19.60	18.25	19.50	Sept. '22, K 0.25
Porcupine Crown.....	Toronto	*24	*23	*24	July '17, Q 0.03
Portland.....	Colo. Springs	*50	*40	*40	Oct. '20, Q 0.01
Schumacher.....	Toronto	*58	*56	*57	.....
Silver Pick.....	N. Y. Curb	*87	*80	*86	.....
Teek Hughes.....	Toronto	*5	*4	*4	Dec. '19, Q 0.02
Tom Reed.....	Los Angeles	1	1	1	July '22, Q 0.15
United Eastern.....	N. Y. Curb	*4	*4	*4	Jan. '20, Q 0.01
Vindicator Consol.....	Colo. Springs	*5	*4	*4	.....
Vipond Cons.....	Toronto	*70	*56	*68	.....
White Caps Mining.....	N. Y. Curb	*16	*13	*16	.....
Wright-Hargreaves.....	Toronto	3.40	3.10	3.25	July '22, Q 0.02
Yukon Gold.....	N. Y. Curb	1	1	1	June '18, Q 0.02
SILVER					
Batopilas Mining.....	New York	†1	†1	†1	Dec. '07, I 0.12
Beaver Consol.....	Toronto	*33	*32	*33	May '20, K 0.03
Coniagas.....	Toronto	*26	*23	*26	Jan. '17, Q 0.12
Crown Reserve.....	Toronto	*26	*23	*26	Jan. '17, Q 0.05
Kerr Lake.....	N. Y. Curb	3	3	3	July '22, Q 0.12
La Rose.....	Toronto	*29	*28	*28	Apr. '22, Q 0.10
McKinlev-Dar-Sav.....	Toronto	*30	*28	*30	Oct. '20, Q 0.03
Mining Corp. Can.....	Toronto	.....	.....	*90	Sept. '20, Q 0.12
Nipissing.....	N. Y. Curb	6	6	6	July '22, Q, X 0.50
Ontario Silver.....	New York	6	6	6	Jan. '19, Q 0.50
Ophir Silver.....	N. Y. Curb	.....	.....	*12	Jan. '12, Q 0.10
Temiskaming.....	Toronto	*47	*40	*40	Jan. '20, K 0.04
Trethewey.....	Toronto	*6	*5	*5	Jan. '19, Q 0.05

GOLD AND SILVER					
Boston & Montana.....	N. Y. Curb	1	*82	*83	.....
Cash Boy.....	N. Y. Curb	*10	*9	*10	.....
Dolores Esperanza.....	N. Y. Curb	2	2	2	July '22, Q 2.50
El Salvador.....	N. Y. Curb	*16	*12	*14	.....
Jim Butler.....	N. Y. Curb	*6	*6	*6	Aug. '18, SA 0.07
Jumbo Extension.....	N. Y. Curb	*8	*8	*8	June '16, Q 0.05
MackNamara M.&M.....	N. Y. Curb	*9	*8	*9	May '10, Q 0.02
Tonopah Belmont.....	N. Y. Curb	1	1	1	July '22, Q 0.05
Tonopah Divide.....	N. Y. Curb	*86	*78	*86	.....
Tonopah Extension.....	N. Y. Curb	2	2	2	July '22, Q 0.05
Tonopah Mining.....	N. Y. Curb	2	2	2	Apr. '22, SA, X 0.07
West End Consol.....	N. Y. Curb	1	1	1	June '22, SA 0.05
SILVER-LEAD					
Caledonia.....	N. Y. Curb	*70	*70	*70	Jan. '21, M 0.01
Cardiff M. & M.....	Boston Curb	5	5	5	Dec. '20, Q 0.10
Chief Consol.....	Salt Lake	*24	*23	*23	Aug. '22, Q 0.10
Columbus Rexall.....	Montreal	27	26	27	Oct. '20, Q 0.62
Consol. M. & S.....	Salt Lake	.....	.....	†1.30	July '20, Q 0.10
Daly Mining.....	Boston Curb	*4	*3	*3	Apr. '21, K 0.05
Eagle & Blue Bell.....	Spokane	*3	*2	*2	May '20, SA 0.03
Electric Point.....	New York	15	14	15	Jan. '09, Q 1.50
Federal M. & S.....	New York	61	57	61	June '22, Q 1.25
Florence Silver.....	Spokane	*33	*33	*33	Apr. '19, Q 0.01
Grand Central.....	Salt Lake	†65	†60	*61	Jan. '21, K 0.01
Hecla Mining.....	N. Y. Curb	7	7	7	June '22, Q 0.15
Iron Blossom Con.....	N. Y. Curb	*29	*29	*29	Apr. '22, Q 0.02
Judge M. & S.....	Salt Lake	†3.80	†3.50	3.40	Sept. '20, Q 0.12
Marsh Mines.....	N. Y. Curb	*13	*12	*13	June '21, I 0.02
Prince Consol.....	Salt Lake	*10	*9	*9	Nov. '17, Q 0.02
Rambler-Cariboo.....	Spokane	*3	*3	*3	Feb. '19, Q 0.01
Rex Consol.....	N. Y. Curb	*11	*9	*9	.....
Standard Silver-Ld.....	N. Y. Curb	*18	*18	*18	Oct. '17, Q 0.05
Stewart Mines.....	N. Y. Curb	*8	*7	*7	Dec. '15, Q 0.05
Tamarack-Custer.....	Spokane	3.25	3.20	3.20	Jan. '21, K 0.04
Tintic Standard.....	Salt Lake	1.95	1.95	1.95	Dec. '21, Q 0.05
Utah Apex.....	Boston	2	4	2	Nov. '20, K 0.25
Wilbert Mining.....	N. Y. Curb	.....	.....	*5	Nov. '17, Q 0.01
VANADIUM					
Vanadium Corp.....	New York	53	50	51	Jan. '21, Q 1.00
ASBESTOS					
Asbestos Corp.....	Montreal	66	66	66	July '22, Q 1.50
Asbestos Corp. pfd...	Montreal	.....	.....	82	July '22, Q 1.75
SULPHUR					
Freeport Texas.....	New York	24	22	23	Nov. '19, Q 1.00
Texas Gulf.....	New York	51	49	51	June '22, Q, X 1.00

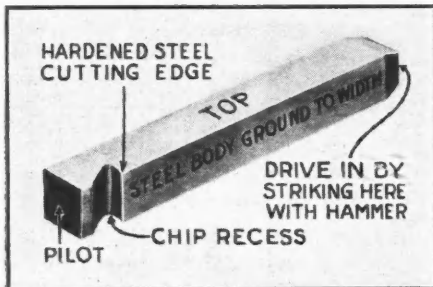
MINING, SMELTING AND REFINING					
Amer. Sm. & Ref.....	New York	65	63	65	Mar. '21, Q 1.00
Amer. Sm. & Ref. pf.	New York	102	102	102	Sept. '22, Q 1.75
Am. Sm. Sec. pf. A...	New York	97	97	97	July '22, Q 1.50
U. S. Sm. R. & M.....	New York	43	43	43	Jan. '21, Q 0.50
U.S. Sm.R. & M. pf.	New York	†48	†45	48	July '22, Q .87

NEW MACHINERY AND INVENTIONS

Self-Fitting Keys

In the metal-mining industries keys are used to make the driving connection between shafts and couplings, gears, sprockets and pulleys. It is usual to mill or slot the keyway in the shaft and to slot the keyway in the external member. But both of these keyway sizes will vary slightly, and to obtain the desired tightness between the key and keyways it has been necessary to carefully fit the parts together. This has usually been done by hand, either by filing the key to fit the keyway or by filing or scraping the keyways to fit the key.

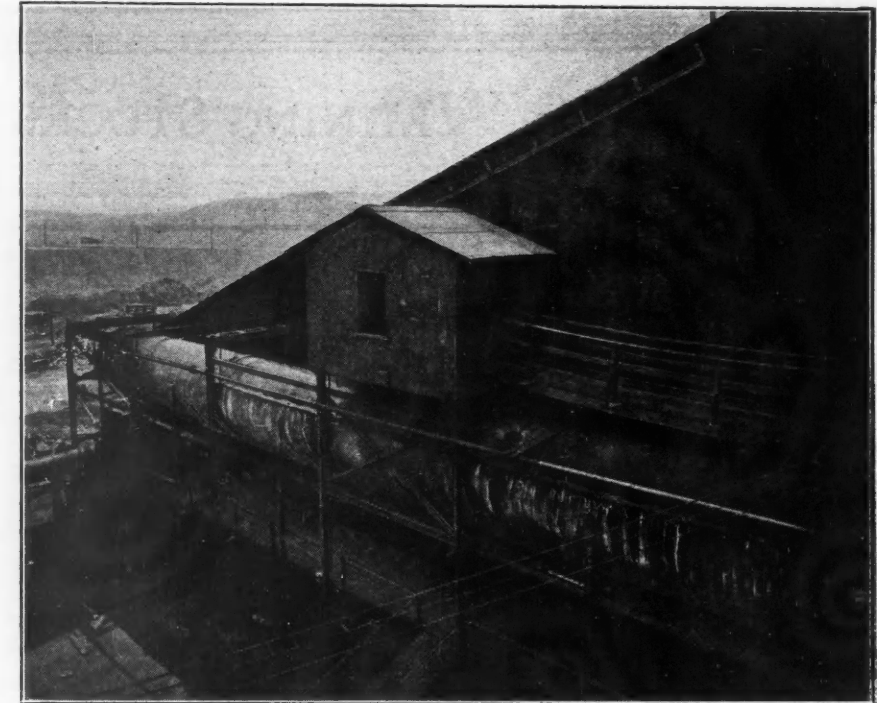
It usually takes a good mechanic three or four hours to fit an ordinary $1\frac{1}{2}$ in. x $1\frac{1}{2}$ in. key. A key slightly smaller, say 1 in. x 1 in., may require only two hours, and in exceptional cases may be fitted well enough in an hour. But the mechanic needs to be experienced, and the key and keyways need to be almost the right size to start with in order to obtain even these results. Such hand fitting generally is expen-



Self-fitting keys for driving connections

sive work, and the results are not always satisfactory.

In the new Keytite self-fitting keys a tough chisel stock is used, and this



A gunitite-covered converter flue

is ground to a size slightly larger than the nominal keyway width. A cutting edge and chip recess are provided near the front end of the key. Ahead of these is a pilot slightly smaller than the nominal keyway width.

To install one of these keys the pilot is entered first with the cutting edge at the side. Then the key is driven home with an ordinary machinist's hammer or with a sledge, depending upon the size of the key. The cutting edge sizes the keyways to make a tight fit between the body of the key and the keyways.

In the larger sizes cutting edges are sometimes provided on both sides. When it is desired to fit top and bottom as well as on the sides, a cutting edge is also provided at the top.

Smith & Serrell, Central Ave. at Halsey St., Newark, N. J., are the general sales agents.

Covering a Converter Flue with Gunitite

The accompanying illustration shows a gunitite-covered converter flue which is being used by the Tennessee Copper Co., Copperhill, Tenn. The original steel flue was first covered with 42-in. triangle mesh (style No. 23) screening, and 3-in. square rods were placed longitudinally 12 in. apart to insure rigidity. A 3-in. coating of gunitite was shot over the entire surface. The flue is 120 ft. 10 $\frac{1}{2}$ in. in length, and expansion joints are provided 29 ft. and 38 ft. from either end. The flue is giving excellent satisfaction and the temperature of the gas handled is from 800 to 900 deg. F.

TRADE CATALOGS

Pneumatic Collecting—B. F. Sturtevant Co. of Hyde Park, Boston, Mass. has just issued a new seventy-two-page engineering bulletin on pneumatic collecting and conveying. It contains thirty-three pages of pictures and diagrams, seventeen pages of useful tables—how to find the size of fans, the suction, volume, r.p.m. and horsepower for any system, cubic feet of air handled per minute, size of pipe and ducts used, and various other valuable tables. Data are also given on dust collecting from grinding and polishing machines, tumbling barrels, sand-blast machines, coal breakers, shoe machinery and the removal of fumes and gases. In addition, there are parts on the conveying of pulverized coal, fibrous materials, coffee, ashes, wool, wood chips, and similar articles. It is a most comprehensive treatise on pneumatic collecting and conveying systems. A copy will be sent on request.



Empty cyanide cans on the dump, Mining Corporation of Canada, Cobalt, Ontario