The Mining Magazine

Managing Director and Editor: W. F. WHITE. *Assistants:* ST. J. R. C. SHEPHERD, A.R.S.M., D.I.C., F.G.S.; F. HIGHAM, A.R.S.M., M.Sc., F.G.S.

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EDITORIAL

COMMENTING here in the May issue on the papers read at the April meeting the Institution the name of one of the authors was incorrectly given as Mr. E. G. Wilson instead of Mr. W. H. Wilson.

AMONG the book reviews published this month is one dealing with the history of Messrs. Chapman and Hall, the well known publishing house, which is additionally interesting in virtue of the signature which appears at the foot of it.

IN continuation of a note here last month regarding Government policy in East Africa, it should be added that these proposals so far as native policy is concerned also cover Northern Rhodesia and Nyasaland and that in connexion therewith a public protest has been registered in Livingstone against the averred injustice to the white settler.

AS everyone is aware, this is the age of large groups. The tendency of the times is for industrial amalgamation of all the different correlated parts of an industry and this is being extended in the direction of the formation of international cartels for the better control of the output of various commodities. It is said to be the inevitable outcome of post-war economic conditions and is often defined by that much used and little understood word "rationalization." At a public dinner some time ago, at which many mining men were present, one of the speakers uttered a warning against this wholesale trustification. There was a danger, in his opinion, of such control of essential commodities becoming monopolistic and passing out of the hands of governments and into those of a few powerful industrial groups. The careful observer cannot but be aware of this tendency, which is shaping side by side with much talk about Imperial unity, mineral resources, and such like. These thoughts are prompted by certain subjects which came under discussion at the recently assembled conference of the Inter-Parliamentary Union, at which a Hungarian delegate called attention to this matter at a session which had been specially convened to examine the operation of cartels and trusts. A resolution was framed which, in spite of some dissentients, was declared to have been carried. The purpose of this resolution, as might be expected, was to suggest, *inter alia*, that trusts should be nationally registered and that governments should be empowered to exercise some form of supervisory control with a view to preventing abuses. That the League of Nations should play its part in the matter of international trusts and exercise a similar control was also suggested. It is hardly necessary to add that the mineral and metal industries of the world would be among those to be principally affected if any such legislation as that indicated were introduced.

Rand Labour

From time to time the question of a sufficient supply of native labour for the gold-mining industry of the Witwatersrand becomes a subject of major importance, while it is one that has continually in latter years exercised the minds of the leaders of the industry. The problem is brought to wider notice by reason of a report which has just been published by a departmental committee appointed by the Union Government to investigate the country's native-labour resources. This committee was set up in response to the persistent demands of the industry for some legislation to assist it in recruiting, the difficulties with which it is confronted being particularly severe since representations were made to stop recruiting in Rhodesia—where all the available labour is required for the copper industry.

The committee's findings are in the nature of an emphatic endorsement of the mining industry's appeal. It appears to have been much impressed with the fact that an occupation such as mining is so much affected by the seasons, while already having very heavy overhead charges to meet. It appears also to have realized how important it is that the number of mining employees should be kept at a maximum, for as the available labour force declines so the tonnage cost must rise, since one of two things must happen—either the management is forced to concentrate on working the richer ore instead of ore of an average grade—a practice which can only be regarded as bad and is usually characterized as "picking the eyes" out of the mine, the result being a pre-

ponderance of unpayable ore reserves—or the mill is kept supplied from reserves, at the expense of the curtailment of development, with subsequent earlier exhaustion. The committee gives instances of how shortage of labour has in the past seriously threatened the mining industry and points out the steadily increasing requirements in recent years on account largely of the greater depths at which work is in progress. Thus normal requirements have increased from 182,000 in 1924 to 207,000 last year, or a rise of 25,000 in five years. These figures are not unnaturally emphasized in the report, which draws special attention to the benefit to the State of the employment of more natives to render workable low-grade deposits at present uneconomic, a question which was discussed in these columns two months ago. The committee has also accepted the estimate with which it was provided of the needs of the mines in the ensuing five years, requirements up to 210,000 being likely. Another factor which was taken into consideration is the effect of the considerable advance which has taken place latterly in the development of other mineral resources, especially iron, asbestos, and manganese, in which industries further extensions are foreseen.

In considering mining labour the committee had to examine the country's native labour question in general and in their survey found that except in agriculture the shortage in other industries is inconsiderable and that there is a surplus of white labour. Since the publication of this report the Government has come forward with a scheme to subsidize the employment of Europeans in posts at present held by natives —a scheme which, incidentally, is said to be a solution of the local unemployment problem. A start is to be made with certain foodstuffs-producing industries and it is suggested that the place of natives working therein should be taken by unskilled white labour paid for at the standard rates, which would be brought up to European levels by the subsidy referred to. If the scheme is successful a quantity of native labour will be made available, some of which it is to be hoped will find its way into the open arms of the mining industry. These happenings, together with the promised Low-Grade Commission, as it has been called, make it appear that the staple industry of the Union is at last receiving the attention essential for its maintenance, and on which the revenue of the country very largely depends.

The Antwerp and Liége Exhibitions

It may not be considered altogether inappropriate at this season of the year to devote some space in these columns to what might be regarded as a non-technical subject and the one which most readily presents itself is the International Exhibition now being held concurrently in Antwerp and Liége in connexion with the celebration of the centenary of Belgian independence. Delegates to the Sixth International Congress of Mining, Metallurgy, and Applied Geology visited the Liége section and some found time to see that at Antwerp as well. For comparison we must look back to the British Empire Exhibition at Wembley, as it is evident that those behind the present endeavour have been to some extent guided by the example set by this country. The Antwerp section is described as a maritime, colonial, and Flemish art exhibition and is truly international in character, there being separate pavilions housing representative national exhibits, while that at Liége is more or less industrial in character, being in the heart of the manufacturing district of the country, although this also has an international aspect.

The Antwerp section is certainly the more striking and is so large as to require a great deal of time for its thorough exploration. Probably most readers will be interested in the British section and this, indeed, is a credit to the Government committee responsible for its organization. As has been said, the exhibition is both maritime and colonial and the arrangement of each of the pavilions of the different countries represented was in keeping with this general description. A brief account of the British pavilion may, therefore, be taken as covering the general characteristics of the contents of many of the others. The British Government Pavilion, to give it its full title, is approached by two bridges over a moat and consists of a domed circular court and two extensive wings. The central feature is a " court of honour," in the centre of which is sunk a map of the world illustrating the extent of the resources of the British Empire. Mural decorations by celebrated artists and historical scenes in diorama complete a very impressive interior. The two wings contain marine, aviation, tropical health, scientific research, industrial, and colonial sections. Here much use is made of the diorama for describing the story of the British Navy, the rise of its people, the

produce of its colonies, and its superior position in the conquest of the air. In the medical section are many exhibits to illustrate man's fight with disease in tropical countries, such as malaria and dysentery. In the colonial section representative exhibits are staged by Nigeria and the Gold Coast, East Africa, and Malaya, in which a feature is made of the minerals produced. Other parts of the Empire have separate representation outside the British pavilion. In the Belgian Congo pavilion there are a number of exhibits to interest mining men. The Société Générale des Minerais, for example, are demonstrating the preparation of ores by flotation processes, Ransomes and Rapier are showing one of their excavators such as are in use in this field, the Société Foraky, of Brussels, are displaying examples of drilling equipment such as is extensively employed in Belgium and its colonies, and the Union Minière du Haut Katanga stage several exhibits, chief among which is that devoted to radium and cobalt.

In the Liége exhibition interest for the engineer naturally centres in the building, the largest in this section, devoted to mining, metallurgy, and mechanical engineering, and the palace of electricity and science is the second point of interest. In the first named pride of place must be given to the exhibits of the local iron and steel industries, among which are some very fine castings and forgings, including steel girders, sheet, rolls, and railway sleepers. A particularly remarkable exhibit is that showing the stages of the rolling of a girder. It is, in fact, a great stepped stem, some 50 feet in length, beginning as an ingot and passing through successive steps, showing the result of 16 passes through the mill, until the other end is in the shape of a girder. The Ougrée-Marihaye enterprise show 60 feet of a 9-ft. wide steel ship's plate, which is as much as could be got into the building. In mentioning these steel exhibits reference should also be made to that by Thomas Firth and Sons, of Sheffield, of examples of their stainless steels. Of non-ferrous exhibits one of importance in the mining building is that of the great Vieille Montagne organization, which concentrates on demonstrating the properties and uses of exceptionally pure zinc, such as they are now producing electrolytically with a guaranteed absence of impurities of more than 0·05 per cent., whilst another is that of the Centre d'Informations du Nickel, which performs the same function in France and Belgium as the Bureau of Information on Nickel in this country. Aluminium is another feature, exhibits being furnished by the Union des Usines d'Aluminium, which represents four large producing works in Belgium and one in France, while outside the palace of mining is a separate pavilion tenanted by the British Aluminium Company, in which the many and varied uses of that metal are ably demonstrated.

The New Geological Museum

Announcement was made in the MAGAZINE for December last of the intention to build a new home for the Museum of Practical Geology, at present housed in Jermyn Street. Operations have now commenced and in the report of the Geological Survey Board of Great Britain just published[1] hopes are expressed that efforts will be made to make the transfer as soon as possible. The new building will form the library and offices of the Survey as well. The site selected, which is in Exhibition Road and midway between the eastern wing of the Natural History Museum and the new buildings of the Science Museum, was first assigned for the purpose by a Select Committee which reported to the House of Commons thirty-two years ago. The new Museum will have direct connexion by means of passages with both its neighbours, thus securing that the mineralogical and palæontological exhibits of the British Museum and the mining, metallurgical, and geophysical exhibits in the Science Museum will be available side by side with those of stratigraphical and economic geology. Such an arrangement will provide in one place a display of specimens illustrating the composition and history of the earth's crust of remarkable completeness.

That this building scheme has now come into being is a direct result of the report and recommendations made by the Royal Commission on National Museums and Galleries, which has been sitting in London under the chairmanship of Viscount D'Abernon during the past three years and has now completed its task. The work on the building will take quite three years to complete, only the excavations having as yet been made. Sir Richard Allison, of H.M. Office of Works, is the architect and, as it was he who designed the new block of the Science Museum, it is expected that the two façades will be in harmony.

[1] *Summary of Progress* of the Geological Survey of Great Britain, Part I, 1929. Price 2s. London: H.M. Stationery Office.

The library and offices of the Survey are to be at the back of the Museum, with direct access from the floors and galleries, a large room being provided for those who wish to study geological maps and literature, which means, with the proximity of the Science Library, a noteworthy centralization of reference work for the geologist and allied technologist. There will be space set apart also for laboratories for chemical, optical, petrographical, crystallographical, palæobotanical, mineralogical, and geophysical work such as has long been deemed necessary. Certain rooms are also expected to be provided exclusively for research work.

The Director's report, from which the foregoing is taken, concludes with some dimensions. The total floor space is about 135,000 square feet, of which the Survey offices, laboratories, and library will occupy 40,000 square feet. The exhibition space, on the main floor and first and second galleries, amounts to 53,000 square feet and the basement furnishes a further 25,000 square feet for use as storage, workshops, and other purposes. The topmost gallery will not be open to the public. The additional accommodation that is to become available will be very welcome to the Survey, which for several years has been working under difficulties on account of space limitations at Jermyn Street, where the premises were built about eighty years ago and were originally the home of the Royal School of Mines.

The Zambesi Bridge

In writing in the MAGAZINE for June, 1929, of railway communications likely to be of interest to the copper producers of Northern Rhodesia we referred to the bridge over the Zambesi at Chindio and its significance to Blantyre and possibly to Fort Jameson. This reference was only partly accurate, as the new bridge, work on which has now been commenced in earnest, will not actually cross the river at Chindio, although that is the place where the journey is now broken and will remain so until the bridge is built, passengers and freight being transferred to barges to cross the river—that is, when it is not too flooded or when, on the other hand, there is no river to cross, as in the dry seasons. Under certain conditions delays of several weeks can occur and the need for a bridge is manifest, but Chindio does not happen to be a convenient place for its construction.

A suitable position for the bridge has been found, however, at Sena, 28 miles up the river from Murraça, which is the point opposite Chindio on the south bank, where the Trans-Zambesi Railway from Beira now ends. Actually the new line to connect with the south end of the bridge will branch off about five miles south of Murraça and will run along a raised earth embankment parallel to the river up to Sena. Here the bridge will cross the river at right angles to a point—Mutarara—on the north bank, whence a line will be laid for three miles, partly through a rock cutting, to connect with the Central African and Shire Railway

system at Bawe Siding. The bridge, which will be known as the Lower Zambesi Bridge, to distinguish it from the Victoria Falls Bridge, will be the second longest in the world, 18 of the 30 spans being on land, on account of the tendency to floods in the district.

Reference to the map will show the importance of this improved railway service to Northern Rhodesia, as it will be seen that a line is projected from Blantyre, via Matope and Dedza, to Fort Jameson, whilst its interest to Nyasaland is enhanced by the prospective connexion from Matope to Fort Johnston, at the southern extremity of Lake Nyasa. No work has, however, yet been done on either of these extensions.

REVIEW OF MINING

Introduction.—The past month has maintained its reputation as "the silly season." "A good deal attempted but nothing done" would seem to be the result of the past Parliamentary session, during which unemployment figures have continued to rise. There are, however, indications that the period of depression, which has affected other countries as well as our own, is passing.

Transvaal.—The output of gold on the Rand for July was 871,468 oz. and in outside districts 41,184 oz., making a total of 912,652 oz., as compared with 887,867 oz. in June. The natives employed on the gold mines at the end of the month totalled 201,111, as compared with 201,324 at the end of June.

Southern Rhodesia.—The output of gold from Southern Rhodesia during June was 45,208 oz., as compared with 47,645 oz. in May and 48,406 oz. in June of 1929. Other outputs in June were: Silver, 6,847 oz.; copper, 117 tons; coal, 79,599 tons; chrome ore, 24,833 tons; asbestos, 2,175 tons; mica, 25 tons.

Milling at the Mayfair mine, which was suspended in January last owing to failure of the power plant, was resumed at the end of last month.

Northern Rhodesia.—Shareholders of N'Changa Copper Mines, Ltd., have been informed of the results obtained from bore-hole B. 36, which entered the lower or River lode horizon at a depth of 1,390 ft. To 1,420 ft. the copper content varied from 0·2% to 9·5%, but from 1,420 ft. to 1,495 ft. it averaged approximately 13·4%, which was stated to be chiefly sulphide. The hole being situated near the adjacent border of the Rhodesian Congo Border Concession there are interesting possibilities within that company's property.

The report of the Bwana M'Kubwa Copper Mining Company, Ltd., for the year ended March 31 last shows that the output of copper oxide during the period mentioned was equivalent to 6,774 short tons of refined copper. The ore reserves above the 250 ft. level and including some tailings and slimes are estimated to be 2,539,811 tons, averaging 3·96% copper. The year's working resulted in a profit of £60,250, against a loss of £23,687 during the previous year. Sales of copper increased from £423,567 to £459,183 and the costs per short ton at the mine were £52 7s. 6d., as compared with £60 5s. 4d. the year before. On the N'Kana mine diamond-drilling has proved the presence of three ore-bodies, extending over nine miles along the eastern limb of the N'Kana syncline, which contain 70,000,000 tons of ore averaging 4% copper, of which 63,000,000 tons are classed as sulphide ore. None of the ore-bodies has been delimited in depth. Attention is now being directed towards bringing the mine to the production stage. On the Mufulira property 45,000,000 tons of ore, containing 4·68% copper, mainly as sulphides, is indicated by drill-holes. Shaft-sinking has commenced and the equipment of the mine for dealing with 2,000,000 short tons of ore per annum is said to be well advanced. Work on the N'Kana concession has continued steadily, the existence of valuable ore-bodies having been proved in the Chambishi, Baluba, and Luansobe areas. The capital of the company is to be increased to £3,750,000 by the creation of 1,000,000 new 5s. shares.

During 1929 the Rhodesia Broken Hill Development Company, Ltd., made considerable improvements in the electrolytic zinc plant, where 60,183 tons of zinc-bearing materials, mainly zinc silicate ores, was treated for an output of 12,121 tons of zinc, as compared with 9,579 tons in the previous year. In addition 1,635 tons of lead was recovered from 12,310 tons of ore, but lead production was suspended in July of the year under review owing to the exhaustion of sulphide lead-zinc ore above the water level in the mine, although there are large reserves of this ore below the 225 ft. level. The output of vanadium concentrates was 445 tons and a new plant for the production of fused vanadium oxide is being erected. Exploitation of the high-grade sulphide ore proved by diamond drilling below the 225 ft. level will require a new shaft and pumping equipment and this matter is under consideration. The profit for the year was £6,531, of which £3,585 has been written off and £2,946 carried forward. During the year £250,000 of First Mortgage debentures were created.

The report of Loangwa Concessions (Northern Rhodesia), Ltd., for 1929 states that during the year 14,089 sq. miles of country was thoroughly prospected and that, although it was impossible to record any discoveries of commercial value, there were several occurrences which warranted further investigation.

Nigeria.—The report of the Nigerian Electricity Supply Corporation to February 28 last states that construction work has

proceeded according to plan and that power was delivered to the first mining company on June 9 of the current year. During the period under review construction work only was carried out. The power house contains three generating sets of 2,000 h.p. each, capable of supplying 4,000 h.p. continuously throughout the year, one unit being held in reserve. The reservoir was completed well within the specified time and will enable power to be generated during the whole of the year.

Australia.—That threatened mines live long is exemplified by the report of the Great Boulder Proprietary Gold Mines, Ltd., for the year 1929, which shows that as a result of development work during the period mentioned 84,592 tons of ore was added to the reserves, which, after allowing for 85,342 tons treated, stood at 80,372 tons, as compared with 81,122 tons at the end of 1928, while the average grade rose from 9·11 dwt. to 9·77 dwt. The reserves do not include ore developed by tributers, although the development of new ore simultaneously with tribute operations is being continued. As has already been announced in the MAGAZINE, diamond drilling on the 1,100 ft. level has had encouraging results and further work is in progress to prove the extent of the ore-body. The company's share of bullion for the year realized £168,594 and the total amount available for distribution was £59,127, of which £23,875 was absorbed by dividends and tax provision, while £35,252 was carried forward.

Diamond drill-hole No. 22, put out east from No. 3 lode of the Lake View and Star at a point 910 ft. south of the Main Shaft, 1,500 ft. level on the Golden Horseshoe lease, passed through lode material aggregating 58 ft. in width. In this there were three sections of payable ore, one of 3 ft. assaying 58s. per ton, a second of 4 ft. assaying 33s. per ton, and a third of 2 ft. assaying 71s. per ton. This formation corresponds in position with the Maclaren shoot of ore in the Horseshoe No. 4 lode at this horizon and from the varying grades of ore intersected it is probable that the lode has been cut near a fault. The first unit of the new flotation plant, having a capacity of 5,000 tons per month, is now working and is said to be completely successful.

The unions concerned have been informed by the managements of the Broken Hill group, including the North Broken Hill, Broken Hill South, Zinc Corporation, Sulphide Corporation, Block 14, and Amalgamated Zinc, that the existing working agreement will be terminated on November 1 next on account of the critical state of the industry. The managements are ready to enter into immediate negotiations for a new agreement and the Broken Hill Workers' Industrial Council has announced its willingness to negotiate.

At the annual general meeting of the Zinc Corporation, held towards the end of July, reference was made to a company called Gold Mines of Australia. It is learned that this company is registered in Australia, with a capital of £500,000 in 10s. shares, the directors being Sir Arthur Robinson, Mr. Colin Fraser, and Mr. M. L. Baillieu. The capital required by the company to date has been supplied by mining and smelting companies in Australia and it has acquired for cash the Mount Coolon mine and has under development option the Barclay and Dig Again mines, as well as owning the surrounding leases, which comprise the whole of the Mount Coolon Goldfield, situated near Collinsville, Queensland.

In January last shareholders of the Federation Tin Mines, Ltd., were informed that, owing to the incapacity of the mill, as installed, to deal with the exceptionally fine tin occurring in the ore, it would be necessary to raise funds in order to provide additional plant. A further circular issued last month states that a scheme has been agreed to by creditors and debenture holders of the company in England and that the consent of those in Australia is being obtained. Under this the directors are authorized to create and issue a further £17,500 First Mortgage debenture stock ranking *pari passu* with the existing £22,500 of similar stock, the redemption of the whole issue and of £7,500 8% second debentures being postponed until January 1, 1935, and unsecured creditors accepting 8% income notes. The scheme is subject to at least £9,000 of the new stock being subscribed at par on or before August 30, and to the necessary consents arriving from Australia. If the £9,000 is subscribed, additions to the mill, which will raise its capacity to 150 tons per day, will be put in hand and when these are completed it is estimated that profits will be made with tin at its present price.

New Guinea.—A circular to shareholders of Edie Development Company

from the liquidator states that the assets of the company permit of a distribution of 187½ New Guinea Goldfields shares of £1 each and 2s. 1d. in cash per 100 Edie Development shares. The distribution is to be made immediately against the return of Edie Development certificates.

Malaya.—At an extraordinary meeting of shareholders of Temengor Tin Mining Company, Ltd., held at the end of last month, the main conclusions of the engineers deputed to report on the property were explained. It was revealed that in the opinion of Messrs. Osborne and Chappel the mine cannot be worked by hydraulicking alone, that its future is bound up in its crushing potentialities, and that further investigation will be necessary before these can be ascertained with any degree of certainty.

Burma.—As was foreshadowed at the meeting of the Theindaw Tin Company in May last, an amalgamation is proposed of four allied companies of the Anglo-Oriental group which are operating in Burma. The directors of these companies—Tavoy Tin Dredging, Thingandon Tin Dredging, Northern Tavoy Tin Dredging, and Theindaw Tin Dredging—have decided that a consolidation of interests is to be desired and that complete amalgamation provides the most satisfactory method of achieving this aim. The scheme put forward provides for the acquisition by the Tavoy Tin Dredging Corporation of the shares of the other three companies, one fully-paid share of Tavoy Tin to be exchanged for each share of Northern Tavoy Tin or for each two shares of Theindaw Tin or Thingandon Tin. In addition it is proposed to increase the capital of Tavoy Tin to £500,000 and also to issue £125,000 of 7½% debenture stock, which will be offered to shareholders, the London Tin Corporation having agreed to take up the balance after applications from shareholders have been satisfied.

Korea.—Shareholders of the Chosen Corporation, Ltd., have been informed of the discovery of a new vein on Moo-dong-San (formerly known as Prospect No. 41), which lies about three-quarters of a mile north-west of the Great Nurupi mine.

Mexico.—At an extraordinary general meeting of Mexico Mines of El Oro, at the beginning of the month, it was resolved voluntarily to wind up the company and a liquidator was appointed, who was authorized to distribute among the contributories 1,600,000 shares, of 25 milreis each, of the Companhia Agricola Florestral e de Estrada de Ferro "Monte Alegre," in the proportion of eight Agricola shares for every five Mexico shares.

Yugoslavia.—At an extraordinary general meeting of Trepca Mines, Ltd., held towards the end of July, it was resolved to increase the capital of the company to £1,125,000 by the creation of 500,000 new ordinary shares of 5s. each. An immediate issue of 400,000 of these new shares has been made, these being offered to shareholders in the proportion of one new share for every ten shares held. It is stated that the plant at the mine has been completed ahead of the specified time and that it will be in full operation by the end of August. A progress report to the end of June reveals that an arrangement has been made with the Elbof Geophysical Company to carry out surveys over certain areas during the summer.

Anglo-Oriental Mining Corporation.—It has been announced that the 1,000,000 recently created ordinary shares of the Anglo-Oriental Mining Corporation have been placed with a powerful mining group, believed to be the Consolidated Gold Fields of South Africa, Ltd. The directors of the corporation state that they have received adequate assurance that the shares have been bought as an investment and not for resale and that the transaction gives strength to the corporation at a time of depression in the tin industry, as well as adjusting the balance of preference and ordinary capital issued.

Mining Trust.—Shareholders of the Mining Trust, Ltd., have been informed that a substantial interest in the company has been acquired by the American Smelting and Refining Company, which has provided capital for the development of Mount Isa and for refinery construction and agreed to act as technical advisers over a period of ten years.

Tin Producers' Association.—A circular issued last month stated that no fewer than 94 companies operating in British Territory and in Siam had agreed to the proposal for a periodical suspension of production, whilst a letter from Sir William Peat, chairman of the executive committee, indicated that foreign support was also assured. Of even greater importance, however, was the decrease shown in the visible supplies at the end of July and the increased deliveries last month to the United States.

AN OUTLINE OF THE GEOLOGY AND MINES OF THE SMEINOGORSK AND ZYRIANOVSK CONCESSIONS IN WESTERN ALTAI

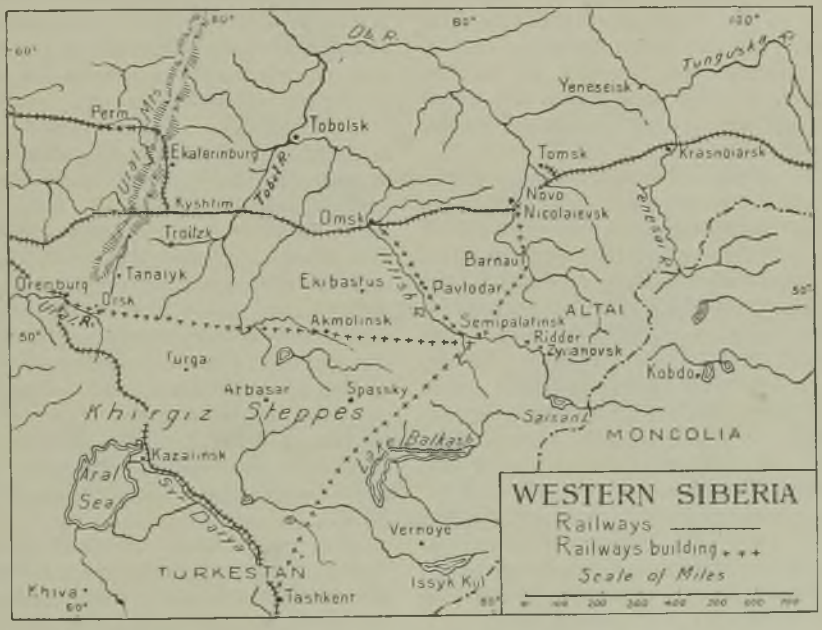
By G. T. EVE, A.I.M.M.

The author, lately Chief Mine Geologist to the Lena Goldfields Company, gives results of a preliminary survey of this Russian mining district.

INTRODUCTION.—In 1929, the author, in his capacity as Chief Mine Geologist to the Lena Goldfields Company, undertook the first steps for a study of the mines which belonged to that company in the Smeinogorsk-Zyrianovsk districts. As the Company ceased to function at the beginning of 1930 the work was not finished, and only a part of the preliminary field study was done. Nevertheless the observations made are of considerable interest.

The Company held two districts in concession. The first, the Smeinogorsk district, is located in the basins of the Rivers Uba and upper and middle Alei, with a few smaller tributaries of the River Irtysh included. The second, the Zyrianovsk district, is situated almost entirely in the basin of the River Buktarma. Between these two districts is situated Ryddersk, retained at the time by the Russian state. The total area of both districts held in concession was roughly about 15,000 sq. miles.

The Zyrianovsk district is situated entirely in the foothills of the W. Altai. In the less explored upper reaches of the right affluents of the River Buktarma there is difficulty of access, it being heavily timbered and very sparsely populated. The same is more or less true of the N.E. part of the Smeinogorsk district, but the southern part of it runs out into the perfectly flat prairies which are very rich agriculturally and comparatively well populated. Neither of these districts crosses the River Irtysh which forms their natural boundary on the S.W. side.



The scenery and climate of the W. Altai are of the most beautiful and perfect the author has seen in his rather extensive wanderings. The variety and wealth of the flowers, especially in the Uplands,

are on a scale surpassing the imagination, and the upper reaches of the rivers are a fisherman's paradise, the streams abounding in a species of Siberian trout running up to 3 lb. and over.

The great difficulty encountered by the author in the preliminary study of the district was an absence of sufficiently large scale reliable maps. The best and the only available map (topographical — there is no geological) which was placed at the Company's disposal by the Russian government was on a scale of about 7 miles to the inch. Taking into account that according to the author's observations it erred in some places by as much as 20 miles, the difficulties which were encountered are obvious.

Coming home on leave in November, 1929, the author left all his field notes, sketches, etc., together with his personal belongings at the Company's headquarters in Moscow. He did not return to Russia, and has endeavoured in vain to recover his property, so that these notes are taken from a preliminary report presented to the Company.

General Geology.—According to the statement of the Russian geologist Kotulsky, who is an authority on the geology of Altai, the greater part of the Western Altai region consists of late Palæozoic sedimentary rocks, together with porphyry, porphyrite and tuffs. The sedimentary rocks are broken through by much younger granites and by a series of dykes ranging from granophyre and quartz porphyry to diabase.

A glance at the geological sketch map reproduced here shows that the structure of the district follows more or less a N.W. direction. Parallel to this line are aligned the longer axes of the laccoliths of the granites with the effusive rocks accompanying them. The strike of mineralized belts on the whole coincides with this line.

There are, of course, local deviations from the general strike. This is the result of upthrust along the line of contact with the porphyries and granite laccoliths. For example, on the ridge along the Ivanovsky hills, on the way from Chesnokovka to Zyrianovsk, occurs the upper part of a recently uncovered granite laccolith, and the slates adjoining this on its northern side have an almost due E.–W. strike. The Zyrianovsk field also gives an example of a local deviation of the strike of the schists under the influence of the laccolith of the Orel mountain with its accompanying mantle of quartz porphyries. The strike of schists in the group of the Grekhovsky-Putintzevsky mines is in general towards N.W. Passing near Zyrianovsk, however, a part of the schists deviates from the general strike and gradually takes an almost E.–W. direction (Tiginsky mine). Such an occurrence is, however, exceptional. As a general rule the direction of the strike follows the main tectonic line, and the general direction of the Alei, Irtysh and Uba granite massifs is N.W. The same is true of the strike of schists wedged between these massifs. A similar occurrence is also noticed in the Zyrianovsk district of the concession.

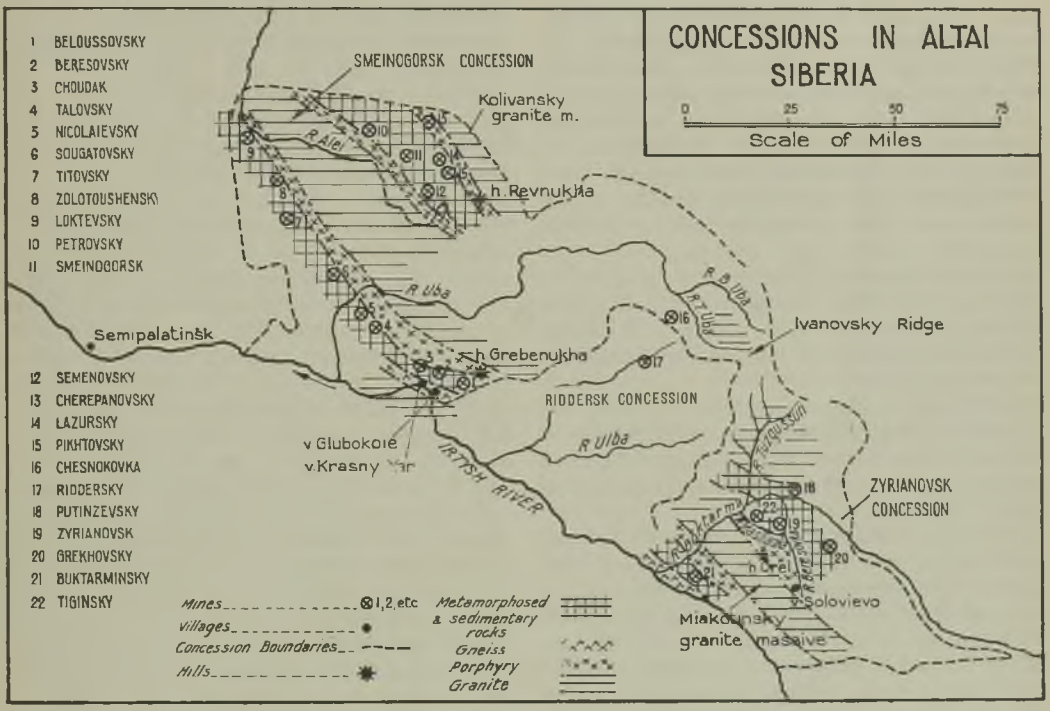
The mineralized belts tend to follow the predominating strike. The mineralized belt represented by the mines Beloussovsky-Beresovsky-Choudak-Talovsky-Nicolaievsky-Sougatovsky-Titovsky-Gerikhovsky-Zolotoushensky-Loktevsky, trends generally N.W. and maintains its direction for a distance of nearly 150 kilometres. Towards the S.E. from the Beloussovsky mine, the existence of this belt is unknown, but it is possible that after crossing the Uba and Buktarma Rivers, it passes through the Buktarminsky mine (gneisses in the mouth of the River Buktarma). A less mineralized belt in the central Uba district has also a N.W. direction of strike. The Smeinogorsk mining belt also follows the prevailing strike, deviating southwards at its south-westerly end. This deviation is again of a local nature and is the result of the influence of the granite massif of the hill Revnukha. Finally the belt Smeinogorsk-Riddersk-Zyrianovsk also runs N.W.

The appearance of mineralized zones is not connected exclusively with the belts described above. The main zones, however, and the greatest intensity of the mineralization are expressed only in the aforesaid belts. The main tectonic line is also not entirely constant in direction, as there is a gradual and very slight convergence of the strikes towards the S.E.

The strike of the main fissures is the same as the main tectonic line, N.W., with a dip towards N.E. The predominating direction is very characteristic of ore deposits located in the sedimentary rocks. Mineralized fissures in the effusive acid rocks and the dykes of the effusive basic magma, however, trend N.E. generally and dip S., although a few N.–S. occurrences have been noted. These

veins usually cross the veins of the predominating strike. They are more recent and were formed as the result of forces which were active after the main folding of western Altai. Judging by the comparatively restricted nature of such fissures, the forces responsible were not strong or lasting, but it is possible that faults observed in this part of the Altai, are due to the influence of pressure directed at an angle to the main direction of folding. Slight folding developed perpendicularly or at an angle to the main Ubo-Aleisky massif, (4) a narrow belt of the Irtysh granite.

(*b*) *Aplites* and *pegmatites* are occasionally found, and there are powerful *quartz veins* in the Beloussovsky-Beresovsky belt. These veins occur especially to the S.W. of this belt. They have a N.W. strike and probably they are the extreme acid phase of the pegmatites. A similar vein at Grebenukha hill, N.E. from the Beloussovsk mine, contains specularite, so that there is a possibility that these veins have been formed at a



folds, has been observed to the North of Glubokoie, and this partly confirms the possibility of such side pressure.

Rock Types.—The main rocks to be found in the Smeinogorsk-Zyrianovsk concessions are as follows :—

(*a*) *Medium-grained, light grey, biotite-granite.* Occasional two-mica, muscovite, and amphibole types have been found. These occur as elongated laccoliths with the direction of the axes due N.W. Within the concession the following granite massifs have been observed : (1) Kolivansky massif, (2) massif on the watershed between the Tchernaia and Belaia Uba. To this massif the Turgusun-Ivanovsky granite massif apparently adjoins in the East. (3) The greater depth than the neighbouring lead-zinc-copper deposits.

(*c*) *Granite-porphyry.* This is a local occurrence, belonging to the marginal phase of the lacolliths, as for example on the ridge of Ivanovsky Belki.

(*d*) *Gneisses* and *gneissose-granites.* These occur in the southern part of the district and near the mouth of the river Buktarma. They strike N.W. and are of the biotite and muscovite variety.

(*e*) *Quartz-porphyry* and *tuffs* are common. They are generally situated on the periphery of the granite massifs. For instance, the Aleisko-Loktevsky and Kolivansky granite massifs are separated by zones of quartz-porphyry striking N.W. The quartz-

porphyry region of the Beresovsky, Choudak, Talovsky, Nicolaievsky and Sougatovsky mines are wedged between the Uba-Aleisky- and Irtysh-belt granite massifs, with a general N.W. strike. The porphyries are brownish or greyish, seldom white, with compact structure, sometimes felsitic. The sericite schists in the neighbourhood of the Beresovsky and Zyrianovsk mines are in all probability a metamorphosed phase of these porphyries. Most interesting from the point of view of practical application is the metamorphism of the porphyries under the action of ore solutions (opalization, kaolinization, etc., as for example at the Nicolaievsky mine, Choudak and others). Nearly all the deposits in the western Altai occur either in the sedimentary or the metamorphic rocks in the vicinity of the porphyritic effusions or inside them.

(*f*) Rocks less easily recognizable by the naked eye are *grano-diorite*, *porphyrite*, *kersantite*, *gabbro*, and *diabase*.

(*g*) *Contact-altered slates* are present in some places. For example, the halleflintas of the Ivanovsky Belki attain a thickness of over 2 kilometres. Marble-like limestones occur frequently.

(*h*) *Phyllites* are developed chiefly in the Beloussovsky-Beresovsky and Zyrianovsk districts and are represented by chloritic, talcose and quartzitic schists, porphyroids and others.

(*i*) The sedimentary deposits are represented by *clay-slates*, *limestones*, *conglomerates*, *sandstones* and *graywacke*.

Ore Deposits of the Smeinogorsk Concession.—In the list drawn up by the Russian geologist Mamontoff (last century), general information regarding 713 ore deposits is given for the whole of the Western Altai. Information regarding neighbouring rocks are given for 282 as follows :—

In granite . . .	27
,, porphyry . . .	122
,, sedimentary rocks .	133

Within the concessions none of the deposits in granite has given satisfactory results. They were all found to be very small and poor, and this applies also to other regions of the W. Altai. The more important deposits in this region, especially in the Smeinogorsk-Zyrianovsk concessions, are found in the porphyries and sedimentary rocks, with the majority in the latter.

The existence of strongly marked belts of mineralization, usually extended towards the N.W. has already been mentioned. These belts follow the granite massifs adjoining them. They follow the curves of laccoliths, as is seen in the Zyrianovsk field and the south-westerly end of the Smeinogorsk field. In general, the outline of the ore-field near a granite massif follows the outline of the latter. The ore-field itself may be situated in sedimentary rocks, or in the porphyries, in contact with the granite, but it will always be near the granite mass.

In the Smeinogorsk concession there are four main mineralized belts : (1) the Lazursky belt, (2) the Smeinogorsk itself, comparatively short, but rich, (3) the Central-Ubinsky, short and poor, (4) the Beloussovsky-Choudak-Loktevsky belt, the longest and in places very promising. Usually these fields have been divided into so-called copper- and lead-zinc zones of mineralization. There is even a more general classification : Smeinogorsk - silver - lead, Irtysh-copper. This is, however, not the case. The minerals, found in the levels of various mines of the district, except sphalerite, are generally the same and only their quantitative proportions vary. Silica is present everywhere, but barytes varies greatly. In the Choudak (quartz-porphyry) the gangue is quartz, while of the ore-minerals chalcopyrite predominates with pyrite next. In the Sougatovsky mine (quartz-porphyry) the gangue consists of quartz with some barytes and the ore-minerals are chiefly represented by pyrite and less by copper pyrites. At the Nicolaievsky mine (sedimentary rocks) the gangue is chiefly quartz with less barytes and the ore-minerals are chiefly sphalerite, with less galena and still less pyrite (here it is the silver-lead vein which is meant and not the copper vein nearby). The Smeinogorsk mine (slates) has a gangue composed chiefly of barytes, less of quartz (it increases with depth) and the ore-minerals are chiefly sphalerite, with less chalcopyrite, still less pyrite and some galena. At the Talovsky (sedimentary rocks) the gangue is chiefly barytes, with some quartz, and the minerals are chiefly chalcopyrite, with less sphalerite, still less pyrites, and some galena. Although the mines differ according to the quantity of prevailing minerals, the general complex of ore remains almost the same. Choudak for example also contains barytes and galena ; Sougatovsky mine likewise contains galena. The mineralizing solutions were the same and

only the local conditions at the various mines could have influenced the prevalence of the one or the other element. Judging by the complex of minerals the great majority of ore deposits belong to the medium zone of formation, a few to the upper zone of formation (for example the Nicolaievsky mine, where semi-opal occurs) and only the quartz-pegmatites belong to the lower zone of formation. Similar depth conditions apparently also account for the presence or absence of sphalerite. Other influences have probably had some effect, the Choudak, for example, is in all probability much younger than the Beresovsky mine (Choudak's strike is almost due E.–W. whilst the Beresovsky's is almost N.W.).

The effects of paragenesis were active in the whole of the Altai, gossan and oxide ores being widely distributed, and to the latter the Altai is indebted for its fame in the mining world. The following table gives the depths of oxide ores and the levels of underground waters for some of the mines in the Smeinogorsk and Zyrianovsk concessions.

Lowest depth of the mine.	*Name of the mine.*	*Zone of oxide ores.*	*Level of underground waters.*
saj.		saj.	saj.
40	Beresovsky	21–22	abt. 25
60	Beloussovsky	20–50	,, 20
36	Zavodinsk	23–30	over 30
101–108	Smeinogorsk	18–35	abt. 21
111	Zyrianovsk	42–44	,, 23
40	Nicolaievsky	12–37	,, 12
66	Talovsky	10	,, 10
62	Choudak	15–20	,, 10

(1 sajen is equal to 7 ft.)

The width of the zone of oxide ores (20 saj. at the Nicolaievsky mine and 21 saj. at the Smeinogorsk mine) and the fact that the veins usually become narrower below this zone, make it probable that denudation during the existence of these deposits has had little influence in the Altai and that a hot and dry climate prevailed.

The Smeinogorsk Group of Mines.—The Smeinogorsk group of mines consists of two ore-bearing belts : the one represented by the mines—Karamyshevsky-Petrovsky-Smeinogorsk-Commisky-Semenovsky, bordering the Aleisky granite massif (Mokhnatyie Sopki) and the other bordering the Kolivansky granite massif and represented by the mines Cherepanovsky-Lazursky-Pikhtovsky. Both zones are situated at a distance of 3–4 kilometres from the respective granite massifs and the massifs themselves are at a distance of 15–20 kilometres from each other. Between them, parallel to their borders, two chains of porphyry cupolas are situated, together with metamorphic and sedimentary rocks. The general strike of the latter is W.N.W. and they are crossed by numerous veins of diabase, porphyrite, etc., which generally make an angle with the predominating strike of the sedimentary rocks.

The majority of mines of the Smeinogorsk ore-bearing belt belong (according to Beck's classification) to the class of deposits of the so-called precious silver-lead-copper formation, which is marked by the presence of barytes in the upper levels, and quartz and sulphide ores in the lower levels. This class is usually found in the basic plagioclase-augite rocks, or in the sedimentary palæozoic and mesozoic rocks broken through by basic eruptives, while the Smeinogorsk belt itself is situated in the area of palæozoic rocks broken through by porphyry and porphyrite.

Lazursky Mines.—The Lazursky mines are not an isolated occurrence ; they represent only a part of one belt of mineralization, starting from the Sosnovsky mine, situated at a distance of 1½ kilometres to the west of the Lazursky mines. Between the Sosnovsky and the Lazursky mines, at a distance of 250 metres towards the East, are the Hausovsky mine, 550 m. further on the Loktevsky-Lazursky, then follows the strip of the Lazursky mines themselves about 1·5 km. long, then, a further 1·5 km. to the east follows the 1·5 kilometres of the Maslinsky, Vorobievsky, Smirnovsky, Saturnovsky and Pikhtovsky mines. Thus there is one belt of a total length of about 6 kilometres. All these mines occur in the same area of metamorphosed diabase schists and contain nearly the same ore. The Sosnovsky mine contains pyrite, chalcopyrite, and chalcocite, while the Lazursky mines contain zincblende (sphalerite) chalcopyrite, and galena ; the other mines, pyrite and chalcopyrite. The gangue is everywhere quartz and carbonates. Workings were mostly, if not exclusively, effected on the extraction of rich oxide ores and had been stopped when they became exhausted in 1825. Later, from 1845 up to 1848, and from 1864 up to 1874, the Lower and Upper Lazursky mines were again prospected, and from 1874 up to 1884 the adits and shafts were maintained in good order, but no work had been done. In 1885 the

deposits were fully abandoned in connexion with the liquidation of the copper industry in the Altai.

Smeinogorsk Mine.—In the Smeinogorsk mine itself a thick, sometimes stock-like, vein occurs (striking N.W. dip N.E.) extended parallel to the strike and dip of the neighbouring palæozoic rocks. The upper part of the vein is composed mostly of barytes, a little quartz and rich silver, copper, gold, lead and zinc ores. The footwall of the vein is composed of hornstone, which probably is the result of silicification of slate. This hornstone contains a network of fine veins of barytes. The hanging wall is composed of clay slates. The vein, including the hornstone, is in places 120–130 metres thick and is crossed by dykes of porphyrite (1–3 metres thick) striking E.W. to N.E.–S.W. and dipping S. or S.E. The richest part of the vein which in places is as much as 20 metres thick (without the hornstone) is faulted at the N.W. end. It has been worked out completely or partially to a depth of 220 metres.

Similar conditions apply to almost all the mines of the Smeinogorsk district with the exception of the Cherepanovsky and Lazursky mines, of which the former is in the porphyry itself and the latter in schists formed from the metamorphosed diabase.

The mines of the W. Altai were abandoned about 1890 as unprofitable enterprises. The presence of sphalerite, however, which stopped the exploitation of the district, is no longer an obstacle and many metals found in the ore (gold for example), which formerly were either not recognized or not recovered, now decide the scheme of exploitation of the mines.

In order to give a clearer picture of the importance of the Smeinogorsk district, the following table of metals extracted from its mines in the past, compared with some other mines of the Western Altai, is given.

The Karameshevsky, Petrovsky, Melnichny, Smeinogorsky mines all belong to one mineralized belt. This belt is uninterrupted, as the signs of mineralization are noticeable along its whole length and the known mines are only the greatest local accumulations of ore.

Irtysh Belt.—The Irtysh mineralized belt, beginning at the Loktevsky mine in the N.W. passes a number of mines in the S.E. direction and ends at the Beloussovsky mine. To this belt belong mines containing complex ores, among which either silver-lead ore (Beresovsky) or copper ore (Choudak) predominate. In its N.W. part it passes through slightly undulating steppe country generally characterized by lack of outcrops or rock exposures. Further to the S.E., beginning at the Sougatovsky mine, the isolated cupolas of porphyry begin to appear on the surface, the country becoming hilly on the height of the Nicolaievsky-Talovsky mine, intersected with valleys and rich in varied outcrops. This section is the N.E. border of the mineralized area, its S.W. side lying in the flat steppe down to the area of the Beresovsky mine, where it passes completely into hilly country, continuing there until its end—at the Beloussovsky mine.

The Irtysh belt, on its N.E. side, is composed of porphyry which is sometimes 2–3 kilometres wide. After the porphyry to the N.E. follows granite. The S.W. part of the belt is composed of sedimentary and metamorphic rocks. There is a complete absence of outcrops between the Beresovsky mine and the Loktevsky mine. At the Beresovsky mine, the sedimentary and metamorphic rocks are wedged between gneisses (the S.W. side) and porphyry and have a width of about 1 kilometre. This widens towards the S.E., attaining a width of 5–6 kilometres at the Beloussovsky mine. Between the Gloubokoie village and the Krasny Yar, granite appears to the

Name of mine.	*Hand-sorted ore extracted. in tons.*	*% Ag.*	*% Au.*	*% Cu.*	*% Pb.*
Smeinogorsky	2,000,000	0·07	0·0012		
Petrovsky	400,000	0·038			
Lazursky	50,000	0·019/			
Cherepanovsky.	60,000	0·039		6/7·3	
		0·09			
Karameshevsky	50,000	0·031			
Total	2,560,000				
Riddersk up to 1917	350,000	0·032	0·0005	0·8	18
Zyrianovsk	1,000,000	0·085	0·0013		9·6
Sokolnyi (Riddersky)	240,000	0·05	0·0009	0·6	3·5

S.W. behind the gneisses and continues to border them down to the height of the Beloussovsky mine, where the gneisses disappear almost completely.

Talovsky Mine.—The Talovsky mine is situated in the contact-metamorphosed sedimentary rocks on the border of the Uba-Aleisky granite massif, and between this massif and the extensive outcrops of felsitic quartz-porphyry. The deposit is of the nature of a stock-work and it consists of two main ore-bodies (with indications of the existence of two others) the general strike being N.E. The deposit had been prospected on its dip as deep as 140 metres. Iron and copper pyrites predominated, sphalerite and galena were also found. The gangue consisted of barytes in the upper levels and quartz in the lower levels. The thickness of the ore-body was in places 20 metres containing from 8–12% copper in the sorted ore. It is not clear how far this deposit has been worked out. In all about 130,000 tons of hand-sorted ore had been extracted. The mine was closed in 1886.

Choudak Mine.—The Choudak mine is situated approximately 15 kilometres to the S.E. of the Talovsky mine and 25 kilometres N.W. of the Glubokoie village. This mine was worked later than the others, being closed in 1890. This mine was the only mine in the Altai which was properly prospected and developed. Discovered in 1862 it was first prospected and developed along its whole strike and dip, and then worked out, yielding about 20,000 tons of hand-sorted ore containing 11·3% copper. It is situated in felsitic porphyry, has a strike N.E. 25°, and was worked for 80 metres along its strike and for 130 metres down its dip. The maximum thickness of the ore-body was 6–8 metres. The gangue consisted of quartz. It is supposed to have been faulted at its northern end. No signs of mineralization have been noticed in the adjoining area.

Nicolaievsky Mine.—The Nicolaievsky mine is situated on the right bank of the Talovki River to the N.W. of the Talovsky mine, in the Irtysh belt of mineralization, approximately 60 kilometres from Glubokoie on the Irtysh river. The surrounding district is composed of limestone, quartzite, and clay slates, broken through by large outcrops of quartz-porphyry and associated tuffs, as well as by porphyrite. Pilipenko in his "Mineralogy of the Western Altai" gives a cross section of the mine parallel to the Alexandrovsky adit and says: "The adit passed through: (1) 50 metres of marley white clay, mixed with boulders of quartz and hornstone, (2) 20 metres of similar rock containing slightly rounded fragments of hornstone, (3) about 40 metres of green-greyish porphyry, (4) 104 metres of very ferruginous hornstone, (5) 2 metres of brownish oxide-ore, containing malachite and azurite (the first copper vein), (6) about 60–80 metres of "pitchstone" (?), (7) a vein up to 40 metres thick, consisting chiefly of rich silver-lead oxide-ore, (8) about 10 metres of "pitchstone," (9) about 40 metres of porphyry containing the second copper vein, and followed further to the west by felsitic porphyry." Following this the Nicolaievsky deposit consisted of three systems of ore-bodies, two of them secondary and containing copper, and the main, or central ore-body of silver-lead ore. The main Nicolaievsky deposit was worked out by six open-cuts, of which the largest was 160 metres long, 40 metres wide and 20–30 metres deep. The veins were supposed to have a strike N.N.E. and N.S. with a dip to the E. of from 30 to 60°. Some of the veins are supposed to have had a N.W. dip. The ore and the gangue at the pyrite level were composed of: Barytes, galena, quartz, pyrite, hornstone, sphalerite, chalcopyrite, calcite, sericite and chlorite. The characteristic of the deposit is the development of common semi-opal. The zone of oxide ore attained, on the dip, a depth of 75 metres and the sulphide ore was prospected to a depth of 80 metres. Barytes and semi-opal were developed mostly in the hanging wall of the deposit. The mine was discovered in 1749. It was worked up to 1843 and yielded in all about 200,000 tons of hand-sorted ore, containing about 68 tons silver, 800 tons lead and 15 tons copper. It was closed down owing to what was, at that time, a great inflow of water.

The Zyrianovsk Group of Mines.

Zyrianovsk Mine.—The Zyrianovsk mine is situated in the vicinity of the Miakotinsky granite massif, having quartz-porphyry between itself and the massif and being located in a series of metamorphic and sedimentary rocks. It has the exceptional strike of 280°, instead of the usual N.W.

The Zyrianovsk rock-series, commencing approximately 8 kilometres to the S.E. of Zyrianovsk, near the Grekhovsky mine,

has, at first, an average strike of 340° with a steep dip to the N.E. The series gradually turns N.W., continuing under the Buktarma river, passing through the Putintzevsky mine, to be lost in the granite massif of Turgussun and Hamir. Near the junction of the Rivers Maslianka and Beresovka the western wing of this series gradually turns more and more to the west, attaining an E.W. strike at the latitude of the Tiginsky mine (3 kilometres to the west of Zyrianovsk). The Zyrianovsk mine is situated at the apex of this curve.

This rock series is composed of metamorphic and sedimentary rocks, represented by chloritic and sericitic schists, and silicious and argillaceous slates, of which the latter are especially developed in the region between the Zyrianovsk mine and the Buktarma river. On the east occur the greenstones of the Rossomakha mountain, while on the west near the Solovievo village—Zyrianovsk mine, on a line approximately parallel to the Beresovka river—quartz-porphyries and contact-metamorphic types occur, while further west is the granite of Orel Hill. Behind the Maslenka river, this series forms a peninsula, bordered by granite on the west and north. There is, apparently, no convexity of the granite massif on the side of Orel Hill to form the bend in the Zyrianovsk series, but there are indications that the projecting curve of the granite laccolith of the Miakotinsky ridge has not yet been laid bare by denudation, and that it exists at a comparatively shallow depth, covered by exterior phases of its development—quartz-porphyry and the contact-metamorphic rocks to the west of the Beresovka river. The Zyrianovsk mine is situated at the apex of the bend of this series, where the greatest displacement has resulted in the formation of fissures and cavities. At Zyrianovsk this coincided with the presence of active ore-bearing solutions which resulted in the formation of the Zyrianovsk deposit. The existence of solutions coincided or appeared soon after the intrusion of the neighbouring granite laccolith which caused the fissures and bend. This could not have taken place a long time after, because such a zone in the presence of active solutions would have been filled up in any case. It may therefore be concluded that the ore formation of Zyrianovsk is related directly to the intrusion of the granite. The ore formations in the W. Altai are undoubtedly connected solely with a certain kind of granite and it yet remains to determine with what kind.

Altitudes of Some of the Mines of the Altai Concession.—These altitudes were mostly determined by aneroid during 1929.

	metres.
Beloussovsky	288
Zyrianovsk	425
Glubokie	262
Beresovsky	301
Talovsky	469
Nicolaievsky	357
Sougatovsky	441
Titovsky	289
Smeinogorsk	404
Karamyshevsky	418
Petrovsky	418
Cherepanovsky	450
Commissarski	538
Lazoursky	602
Goltzovsky	670
Semenovsky	432
Summit of the Ivanovsky Belki mountains	2,017
Grebenukhe near Beloussovsky	441

Institute of Metals.—The annual autumn meeting of the Institute of Metals is this year taking place at Southampton from September 9 to 12. The proceedings will open with the delivery of the Ninth Autumn Lecture, at 8 p.m. on September 9, by Professor D. Hanson, vice-president of the Institute, on "The Use of Non-Ferrous Metals in the Aeronautical Industry." On the following day at 9.30 a.m. there will be a civic reception given to the members by the Mayor of Southampton, which will be followed by a general meeting at which a number of papers will be read, including several by distinguished metallurgists from abroad. A similar meeting will be held at 9 a.m. on September 11, following which the members will lunch as the guests of the Cunard Steamship Company on board *R.M.S. Mauretania*. Excursions have been planned to include Portsmouth Dockyard, the Supermarine Aviation Works at Hythe and Woolston, the Ordnance Survey Office, the *R.M.S. Mauretania*, the floating docks, and the works of the International Cold Storage and Ice Company, Harland and Wolff, and John I. Thornycroft and Company. Arrangements have also been made for a trip during the week-end to Cherbourg on an Atlantic liner (the *Mauretania*) and a return by the *Aquitania*. The works of J. Samuel White and Company may also be visited by private arrangement.

SPECTRUM ANALYSIS IN ASSAYING

By A. A. FITCH, A.R.C.S., B.Sc.

The author outlines a method of analysis which is finding increasing employment, particularly in the examination of minute samples.

INTRODUCTORY.—Bunsen, and other early workers in the field of spectrum analysis, imagined that the investigations they had initiated would soon lead to the adoption of spectrum analysis methods to replace the generally more laborious chemical methods. That such a rapid development did not take place is to be attributed to several causes. One of these was that the physicists found the methods of spectrum anaylsis invaluable in astrophysics, and most of their attention was diverted to that subject. A more potent factor was the early discovery that spectrum analysis would reveal mere traces of metals, such as one part in several million of sodium, and the early workers were unaware that any quantitative data could be obtained by spectroscopic means: a method of analysis which failed to distinguish traces from larger quantities was obviously of little value to the chemist, and he usually ignored it. There was the further difficulty that electric current was not readily available. The arc was seldom used in the days of batteries, owing to the large amount of current necessary. Moreover, metallurgists, who might have used alloys at that date, were mostly interested in major constituents, with which there were, at that time, no means of dealing quantitatively by the spectroscope.

The idea of using spectrum analysis for obtaining quantitative data appears to have been first tried by W. A. Miller, Assayer to the Mint, in 1863. Hartley, in 1884, was able to carry out copper assays on pyrite spectrographically, but expressed the view that this was as well done chemically, and that he hoped to apply the method to more complex assays, which he seems not to have done, though he did much work on the spectrum analysis of minerals. He was soon followed by de Gramont in France, who worked for many years on the spectrographic analysis of minerals and the related problem of mineral concentrates. More recently, Germany and the United States have supplied many active workers in this field.

Spectrum analysis consists, essentially, in exciting an emission from the metal or mineral concentrate to be examined; either by passing a condensed high tension spark, or by means of a d.c. arc, run on about 200 volts, between two electrodes of the metal. If a.c. only is available, a carbon arc should be used. This emission is split up into its constituent wavelengths by a prism, and the resulting spectrum observed with an eyepiece, or if the ultra-violet is to be examined, the spectrum is photographed.

TYPES OF ANALYSIS POSSIBLE.—The methods of procedure available are very varied and by their use it is possible to carry out analyses involving metals and certain non-metals under almost any conditions. The most valuable application of recent spectrographic methods, however, would seem to be in routine analysis of raw material, or finished product, rapidly to check each batch to see that it satisfies the specification and for the analysis of concentrates during ore-dressing processes, or metallurgical products during the process of smelting. Specific examples are given later.

The method adopted will depend on which of the following types the problem conforms to:—

(*a*) Testing qualitatively for a particular metal.

(*b*) Examining qualitatively for all the metals present.

(*c*) Making approximate quantitative estimates in these cases.

(*d*) More accurate quantitative estimation, which is now possible with an accuracy of about 5% of the amount of the metal present. That is to say a content of 2% would be determined with an error of about 0·1%.

(*a*) *Testing qualitatively for a particular metal.*—This is done by one of several comparison methods. With a visual instrument, the eyepiece pointer is set precisely on one of the "raies ultimes"[1] of the metal which is sought, by observation of an arc of that metal. The arc of the specimen is then observed, and a watch is kept to see if any line appears opposite the pointer. If it does, the metal is present, if not the metal is absent; the conclusion being confirmed by

[1] The "raies ultimes" are the last lines to disappear from the spectrum of the metal as its percentage in the sample gets progressively smaller.

observation of another of the "raies ultimes." With a photographic instrument, the two spectra are photographed one above the other, and the spectrum of the sample examined for the presence of the "raies ultimes" of the metal sought.

Many applications of this kind of analysis could be quoted; one of the more interesting being the sorting of steel in scrap yards. An arc is struck between a piece of mild carbon steel and the sample under examination. The arc is observed with a small visual instrument of special design. (Fig. 1.) It is without adjustments, but its optical train

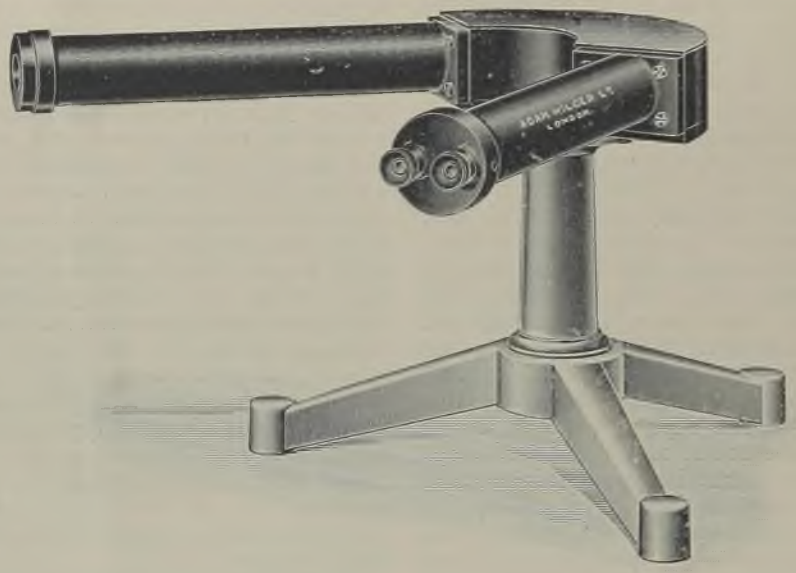


FIG. 1.

is so arranged that in one eyepiece appears a group of chromium lines, and in the other a group of nickel lines, if those metals are present in the steel. The lines seen in the two fields if these metals are present are shown in the lower halves of Fig. 2, the spectrum of pure iron, or nickel- and chromium-free steel in the upper half. By the use of this instrument steel scrap can be rapidly sorted into mild carbon, nickel, chromium, and nickel-chrome types. With some practice, observers are able to sort light bars at the rate of one in thirty seconds. Moreover, with practice, the observers are able to distinguish between steels with varying amounts of these metals. Thus they are able to distinguish regularly the following steels :—

(1) A carbon steel containing less than 0·5% nickel and one containing 1% nickel.

(2) Case-hardening steels containing 2%, 3%, or 5% of nickel.

(3) A 3% chrome steel from a 3% nickel-chrome steel.

(4) Nickel-chrome steels containing 0·5%, 1%, or 1·5% chromium respectively.

(*b*) *Examining qualitatively for all the metals present.*—The best method of carrying out this is by use of the "R.U." powder. The R.U. Powder is so prepared that its spectrum shows the "raies ultimes" of most of the metals, and very few other lines. The procedure is to photograph the spectra of the sample and that of the R.U. powder in juxta-position and to note which lines are common to the two. These lines are readily identified from an enlargement of the spectrum of the R.U. powder, and consequently the metals in the sample are known. Such an examination is a very valuable preliminary to complete assays to the platinum metals, or of rare-earth concentrates such as monazite.

(*c*) *Approximate quantitative analyses.*—The precision of these determinations is often not high, but they merely indicate in a general way the amount of a particular metal present. Thus they will distinguish between 0·01% and 0·1%, but require refinement to obtain any greater accuracy. They depend upon the fact that as the content of a given metal in a pair of electrodes increases, so the intensity and number of lines due to that metal increases in the spectrum obtained from them. The procedure is,

therefore, to examine or photograph spectra of a series of steels, alloys or concentrates of known composition, and to compare the spectrum of the sample to be assayed with it. By this means Hartley was able to carry out accurate copper assays on pyrite. More recently, Meggers, Kiess and Stimson have carried out assays of boiler-plug tins, and of platinum and gold in various stages of refining, by this method. M. G. Lloyd, of the United States Bureau of Standards, has stated that such methods as these are more accurate than chemical means for the estimation of molybdenum and niobium in steel. They are undoubtedly of great value in the determination of base metals in bullion, a difficult and costly process by chemical means.

(*d*) *More accurate quantitative analyses.*—The principle underlying the several methods available for this purpose is that the intensities of the lines of the element to be determined are not found by mere comparison with a standard, but by accurate measurement by some scheme of spectrophotometry. The most convenient of these for metallurgical work generally are: (1) the Barrett twin-spark method, and (2) the logarithmic wedge sector method.

In the first of these, two sparks are run in series, one between a pair of standard pure electrodes, the other betweeen a pair of electrodes of the metal to be examined (say for lead). The optical train is so arranged as to bring the two spectra into the field of the eyepiece, one above the other. The light from the pure metal electrodes is passed through a special polarization photometer, and by turning the upper nicol, the particular lead line selected can be brought to equal intensity in the two halves of the eyepiece, and the lead percentage determined by referring the reading on the upper nicol of the photometer to curves prepared with a set of standard alloys. The method is most successful with quantities above 1%. (Fig. 3.)

The logarithmic wedge sector method has recently been described by Twyman and Simeon in a paper read before the Optical Society. The method is particularly suited to the rapid quantitative analysis of steels, in cases where the highest accuracy is not required. Preliminary results have been given by Scheibe and Neuhausser, and further work on this application has been done by F. Twyman and the writer, the results to be embodied in a paper shortly to be published. It can be stated, however, that it is possible to estimate nickel, chromium, silicon, and probably molybdenum, vanadium and copper, with an accuracy of about 5% of the amount present. The sector is shown in Fig. 4.

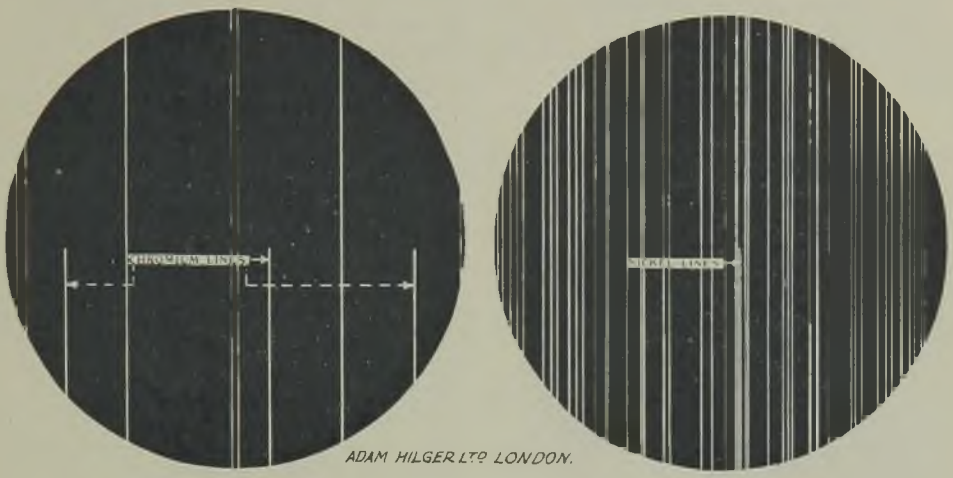


FIG. 2.

USE IN METALLURGY.—The methods which have been briefly described can be used in the analysis of any alloy, but among the types of problems which have been successfully tackled by them may be mentioned the following:—

Routine tests on batches of copper showing low conductivity, to determine whether this is due to arsenic, nickel or some other constituent.

Examination of zinc for indium, gallium and germanium.

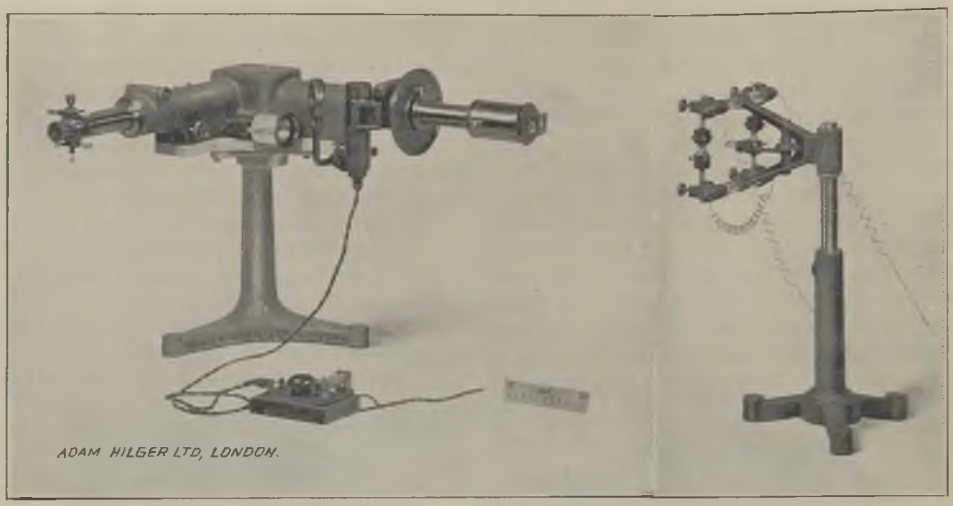


FIG. 3.

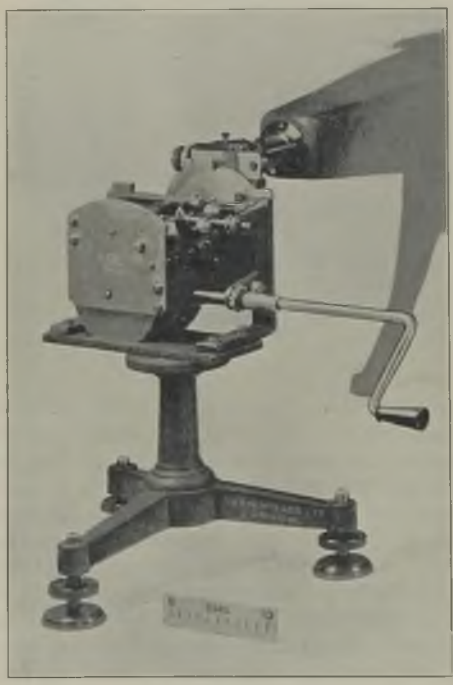


FIG. 4.

Analysis of commercial thallium, showing the presence of lead, copper, antimony and aluminium.

Analysis of electric light bulb filaments.

Estimation of nickel, chromium, silicon, manganese, molybdenum and vanadium in steels.

Estimation of bismuth in zinc and alloys where percentage of that metal must be kept below a few thousandths per cent.

Discrimination of thoriated and unthoriated wire used in the filaments of thermionic valves.

ASSAYS OF MINERAL CONCENTRATES.—This type of analysis has received relatively little attention from spectroscopists. One of the chief difficulties is the accurate sampling of the concentrate to obtain a representative fraction for submitting to the arc or spark. Two methods have been used :—

(*a*) The concentrate is brought into solution, a given weight of mineral being made up to a known volume, and the spark spectrum of the solution examined.

(*b*) The concentrate is finely ground, and compressed into rod-shaped pellets, either alone or with a base of conducting material if the mineral is a non-conductor. Sir William Crookes used very pure silver powder as the base when examining a series of stony meteorites. These rods can be submitted to either the arc or the spark. Apart from the early work of Hartley already cited, and some determinations of silver in galena and other lead minerals by de Gramont, little has been published so far dealing with assays of ores.

What are probably the first mineral analyses to be made in conjunction with work on polished sections in the course of an investigation on a mineralized region are those by Schneiderhöhn on the platinum ores associated with the Bushveld Complex. The problem was to determine the precious metal content of the several ore and gangue minerals. Only a few milligrams of each could be obtained by drilling them out from

the surface of polished sections. Assays on such minute quantities could not be carried out chemically, but with the spectrograph Schniederhöhn was able to estimate approximately the platinum, rhodium, iridium, osmium, palladium and other metals in each of the minerals, and so to determine the history of the mineralization.

The methods which have been devised for the analysis of minerals in solution have been found to be useful for the rapid analysis of solutions of the type obtained in leaching processes for oxidized copper or zinc ores.

CONCLUSIONS.—It can be stated that, in general, spectrum analysis is much more rapid than chemical methods (½ hour to 1 hour will suffice for a spectrographic determination), though the accuracy obtainable is not so high, except when the percentage present is very low. For many alloys and metals these methods have been worked out, and found advantageous; while for certain restricted types of operation (such as those involving the performance of analysis on small quantities of material) the spectrograph is indispensable. In the analysis of concentrates there is a wide field for development. Leaching solutions can be dealt with by the same methods as those used with minerals in solution

LITERATURE.—A great deal has been written on the subject of spectrum analysis, but the following few books and papers include some of the more useful as regards assay work.

1921, *Optical Methods*. Adam Hilger, Ltd.

1922, W. F. Meggers, C. C. Kiess and F. J. Stimson: *Practical Spectrographic Analysis*. U.S. Bur. Standards Sci. Paper No. 444, Vol. 18.

1927, F. Twyman and D. M. Smith. *Quantitative Spectrum Analysis*. Inst. Metals Divn. Amer. Inst. Mining and Met. Engineers, *Technical Publication No.* 79.

1928, G. Scheibe and A. Neuhausser: *Die Schnellbestimmung von Legierungsbestandteilen in Eisen durch quantitative Emissionspektralanalyse. Zeit. f. ang. Chemie*, Vol. 41, p. 1218.

1929, H. Lundegardh: *Die Quantitative Spektralanalyse der Elemente.*

1929, A. A. Fitch, in *Select Methods of Metallurgical Analysis* by W. A. Naish and J E. Clennell (Chapman and Hall), p. 448.

1929, *The Practice of Spectrum Analysis*, Fourth Edition. Adam Hilger, Ltd.

ALLUVIAL PROSPECTING IN SOUTH AMERICA

By H. L. HOLLOWAY

The author gives details of the methods used in prospecting certain alluvial deposits in Ecuador and Colombia.

PROSPECTING WITH SHAFTS IN ECUADOR.—The auriferous alluvials of the Santiago River system in Northern Ecuador can be divided into two distinct groups; one consisting of gravel beaches and low flats covered with varying depths of overburden formed by the present river, and one consisting of benches high above present water level formed by an anterior river system. In parts there is still a third group consisting of low terraces slightly above the present river level, but clearly formed by it.

In the tributary of the Santiago where the writer's work lay, the whole three groups were represented, and the prospecting to be done was to cover the flats, beaches and low terraces. The wash is of a very coarse nature, a great percentage consisting of small boulders of very hard basalt, and it was decided that pitting was the most practical method applicable. The labour available was entirely unpractised in mining, and centres from which to obtain mechanical appliances and materials are distant and, owing to lack of roads, communication was difficult. It was necessary, therefore, to work with as simple an equipment as possible.

The coarse wash was of a very free nature, often without any cohesion, and inflow of water was hard to check and, in addition, a satisfactory timbering system with local materials was not easy to develope.

The following system was the one adopted. The shafts were made 4 ft. 3 in. by 2 ft. 6 in. inside measurement and the shaft was first sunk through the overburden, usually 6 to 7 ft. It was rarely safe to sink more without timbering. Poles were then obtained from the nearby bush, of a diameter of 3 to 4 in., and were sawn into rectangular sets with halved joints at the corners, the inside dimensions being 4 ft. 3 in. by 2 ft. 6 in. These were set in place one above the other making as tight a fit to the walls and to each other as possible. Above ground, a strong bearing-frame was set with four

beams of about 6 in. diameter, notched into each other to form the same inside measurement as the shaft. Laths of split bamboo were used to nail from top to bottom, one at each corner. It was necessary with each lath to make a notch with a cutlass or other tool where the nails were to be driven near the ends, in order to prevent splitting, $2\frac{1}{2}$ in. wire nails being used, which held satisfactorily. A windlass was erected on the bearing frames, the buckets used being of a capacity of $1\frac{1}{2}$ cu. ft., although rather smaller ones would have been better.

While the man in the shaft was loosening the gravel and filling the bucket, those above would be sawing the timber sets, or if water was troublesome, pumping—3 in. diaphragm pumps being used. It was sometimes necessary to use three pumps in one shaft.

When the walls held up well, which was rarely, the shaft man would sink a foot or more each time before timbering. He would then place as many sets in as possible and nail them securely to those above with the bamboo laths. Every few feet of depth, added laths were nailed from top to bottom. When the wash was loose, as was usually the case, only one set was placed in at a time, and nailed. Even so, great trouble was experienced with running-in in some of the shafts. To guard against this as much as possible, leaves and any available vegetation was rammed in at the back of the sets to leave no free space between them and the walls.

Where the running in was troublesome and the pumps had difficulty in keeping the shaft entirely clear of water, a rectangular collar of $1\frac{1}{2}$ ft. by 12 in. sawn timber, slightly smaller than the shaft, was used for sinking, the man working inside and driving it down as he excavated from below, and timbering above. Sampling was done by taking a well mixed cubic foot of gravel from each foot of depth, which was washed by natives in bateas, 45% expansion being allowed in the loose wash over the space occupied in place. A discount was made, varying with the amount of water inflow into the shaft, it being assumed that the water would carry in a certain amount of sand and gold, the coarse wash being held up by the timbering.

Where the running in was small, the whole bulk of wash in addition to the cubic foot samples, was put through a rocker. In each case the bulk value as found by the rocker tallied almost exactly with the mean value as shown by the cubic foot samples.

The cost of the pitting, inclusive of materials, labour and native overseeing, but exclusive of European supervision, was 5s. per foot of depth.

Prospecting with Hand Drills in Colombia.—The alluvial deposits to be tested in this case consisted of moderately coarse wash, the larger stones being about 6 in. in the largest diameter and flattened. Basalt, diorite, and syenite were the chief constituents.

The drill used was a 4 in. "Ward," the pipe sections being in 5 ft. lengths with outside tapered couplings. The headgear consisted of four poles each 22 ft. 6 in. long connected at the apex with a $1\frac{1}{4}$ in. by 18 in. bolt. This passed through the four poles, which were slightly flattened, and through a 12 in. by $1\frac{1}{4}$ in. sheave, set between the two centre poles. To the end of the bolt was attached a small block for the pump rope. The bottom ends of the poles were mortised into two flattened ground timbers.

In moving to a new hole, the tool string cable was thrown over the sheave, the legs of the poles disconnected from the ground timbers, and all lowered to the ground without unbolting the top. The whole rig was then carried to the new location. To take down and reset took only a few minutes.

A windlass was attached to two of the poles, over which was wound the $\frac{5}{8}$ in. wire cable for the tool string. This passed under the walking beam frame and over the sheave. The walking beam frame rested against the windlass by means of a V end, the walking beam being for eight men. When working the walking beam, the cable was clamped to the frame by means of a strong wing screw of suitable length.

To start a bore-hole, a short stem-rod, with link top, was attached to the cable, and to the stem-rod a long chisel bit. The bit near its upper end had a section turned to a smaller diameter, to which could be attached the driving block. The stem-rod also had this turned down section. To centre the hole, the bit was allowed to hang free an inch or so above the ground. The centre obtained, a length of pipe was held vertically in place, and the driving block attached to the bit. This consisted of a block of steel 4 in by 10 in. by 10 in. bored to fit over the bit, in two halves, connected by two bolts. To fix the block to the bit took less than a minute. A driving cap was

affixed to the top of the pipe, the bit lowered inside, and driving was commenced by means of the walking beam.

Core was removed in the usual manner by a flap valve pump, the core after each driving being measured by means of marks on the cable, and its bulk after pumping was again measured in a 4 in. section of galvanised tube.

When hard gravel was reached, the tool string was supplemented by another stem-rod, this time 5 ft. in length. The striking force of the bit with its own weight and that of the two stem-rods, and with a good team on the walking beam, was sufficient to take it through any ordinary gravel without difficulty.

For hard stones, a four winged bit was sometimes used, the stems and bits being screwed together by tapered threads.

The outfit was very effective up to 45 ft. depth under the conditions encountered. By returns from dredging as compared with prospect boring, the figure of values given by the latter was found to be about 10% below actual recovery.

BOOK REVIEWS

The Aluminum Industry. By T. D. Edwards, F. C. Frary, and Z. Jeffries. Cloth, octavo, 2 vols., 358 + 870 pp., illustrated. Price 60s. New York and London: McGraw-Hill.

The book entitled "The Aluminum Industry," published this year, consists of two volumes. The first deals with the extraction and refining of the metal; the second with the properties of the pure metal and its alloys, the fabrication of products and their uses in industry. The authors are Messrs. Frary and Edwards, respectively Director and Assistant Director of Research of the Aluminum Company of America, and Zay Jeffries, the Consulting Metallurgist of the Company. In writing this volume the authors have had the assistance of many of their associates in the Aluminum Company of America and its subsidiaries. It is only five years since Mr. R. J. Anderson's volume entitled "The Metallurgy of Aluminium and Aluminium Alloys" was published in the same country, and yet the present authors say that the available books are either out of date or do not contain authentic information on many of the subjects in which the greatest interest is now being shown. It is to meet this need that the present volumes have been written.

Aluminium—as the reviewer prefers to spell it—has had a remarkable history. One hundred years ago it had not even been prepared. Just about that time the first samples were produced by an ingenious application of chemistry. Fifty years passed before a cheap and sufficiently convenient method of producing it was worked out, and yet to-day it ranks fifth in magnitude of production of the world's metals. The main reason for this extraordinarily rapid advance is that it was born in a scientific age and has had the benefit of modern methods of scientific research to assist its development. There are several unique features about it. It was the first common metal to be produced by electrolysis and indeed cannot be produced economically except in this way. It was also the first common metal to be prepared which is light. Its combination with oxygen is one of the most powerful exothermic reactions that is known and indeed is the foundation of its use as a constituent of thermit. The metal could not continue to exist if it were not for the fact that it is covered with a strong adherent film of oxide as soon as it is exposed to the air which protects it from further oxidation.

The first volume, consisting of 358 pages, covers the history of the discovery of the metal, the development of the industry, the ores and their mining and refining for the production of alumina and the reduction and refining of the metal itself. A special feature of this volume is the great detail in which the production and refining of alumina are treated. This is a field in which hundreds of patents have already been granted. The large number of processes which have already been described makes it difficult for most inventors to know what has already been accomplished. Accordingly the available literature has been abstracted and classified with considerable care. It is possible to apply a simple test of the extent to which the technique of the extraction of the metal has advanced during the five years since the publication of Anderson's book. If its index be consulted it will be found that the word "refining" does not occur in it. Five years ago there was no refining of the metal but only of the alumina from which it was prepared, and the purity of the metal was determined by that of the oxide which was

electrolysed. The present volume contains several pages devoted to this subject. The purest samples of metal as obtained in the first instance by electrolysis seldom contain more than 99·6% of aluminium. The balance consists of iron, silicon, carbon and small quantities of other impurities.

It is satisfactory to find that two methods are now being used for the refining of the metal. In the first, which is the subject of a German patent, the unrefined metal is kept at a temperature rather below the melting-point of the metal, but above those of the impurities which it contains. Under these conditions they liquify and may be separated by pressing the liquid from the solid metal. In the second a method has been worked out and patented by Hoopes with the co-operation of the Research Staff of the Aluminum Company of America which consists in electrolytically refining the metal using a three-liquid-layer cell. The cell itself is divided into two electrically insulated sections arranged with water-cooling at the joints to aid in maintaining the electrical insulation between the sections. This is essential in order to prevent partial short circuits between the anode and cathode through the hot lining. The lower half of the cell contains a carbon bottom lining on which rests the molten anode alloy. Superimposed upon this lies the molten electrolyte and upon this floats the molten cathode. The electrolyte is composed of a mixture of cryolite and aluminium and barium fluorides nearly saturated with alumina. The anode of the cell is an aluminium-copper alloy containing enough silicon to lower its freezing point so that it will remain "adequately mobile" even when the aluminium content has been largely reduced. The working temperature of the cell lies between 900° and 1,100° C. It is operated continuously, the aluminium produced at the cathode being tapped off and a corresponding amount of impure aluminium or aluminium-copper alloy being added to the anode from time to time. It is stated that much of the metal thus refined has a purity of 99·9% and some of it of as much as 99·95%.

The second volume dealing with alloys and the fabrication of the metal and its products is much larger and runs to 870 pages. The early chapters deal *inter alia* with the physical and chemical properties of the metal, the constitution and structure of alloy systems and their properties and a variety of commercial alloys. Chapters then follow on the melting, casting and working of aluminium and its heat treatment. An important chapter is devoted to "joining" processes including riveting, welding and soldering. The coating and finishing of the metal constitutes the subject matter of a separate chapter. The remaining chapters deal mainly with the uses of the metal in the various industries. The amount of information that has been packed into this volume is astonishing and the chapters are full of interest. It is stated on page 353 that aluminium sheet is made commercially with as many as from five hundred million to one thousand million crystals per cubic inch. This gives some idea of the degree of control of crystal size which has now been reached in the heat treatment of the metal. The connexion between mechanical properties and crystal size is of course very close.

It is satisfactory to find the subject of "anodic coating" so well treated. The use of aluminium in the aircraft industry is to a great extent dependent upon protective coatings of this kind and in working out suitable methods Bengough, Stuart and Sutton have rendered valuable service in this country. The coatings can be reinforced so as to give still greater protection against corrosion by means of a thin film of grease. This can be applied by dissolving lanoline in a suitable solvent and spreading the solution on the coating or immersing the article in it.

The two volumes in question may be recommended unreservedly to all those interested in the aluminium industry. The information they contain is remarkable for its completeness and accuracy. Every aspect of the subject has been not merely treated, but thoroughly treated. The book has been well printed and the illustrations are unusually good.

H. C. H. Carpenter.

A Hundred Years of Publishing : being the Story of Chapman and Hall, Ltd. By Arthur Waugh, managing director from 1902 to 1930. Cloth, octavo, 326 pages, with many portraits and other illustrations. Price 15s. London : Chapman and Hall, Ltd.

To the ordinary man Chapman and Hall are known as the publishers of Charles Dickens's works, while the engineer associates them with the firm of John Wiley and Sons,

of New York, whose engineering, chemical, and general technical books they handle in this country.

Edward Chapman and William Hall started business as booksellers in the Strand in the year 1830, and in 1836 came rapidly to the front as publishers of *Pickwick*. They acted as Dickens's publishers until 1844 and also from 1859 to his death in 1870, the intervening fifteen years seeing Bradbury and Evans as publishers of his books. One point of considerable interest made by Mr. Waugh relating to Dickens is to the effect that, judging by sales, the *Tale of Two Cities* ranks next to *Pickwick* and *David Copperfield* in popularity; another is that Dickens continues to this day to be a "best seller." Of other celebrated authors doing considerable business with the firm may be mentioned Thomas Carlyle, Harrison Ainsworth, Mrs. Gaskell, Anthony Trollope, and George Meredith. Much amusing information about the dealings between author and publisher is found in this part of the book. Of Carlyle it is said that he grumbled and nursed his grievances at home, whereas Trollope came to the office with a hunting crop in his hand and was always able to obtain his own terms in a contract.

Of the two original partners William Hall died at a comparatively early age in 1847 and from then onward until his retirement in 1864 Edward Chapman was in control. His cousin, Frederic Chapman, had joined the firm in the early days, namely in 1841, and after Edward's retirement assumed control. In 1880 he transferred the business to a limited liability company, for the purpose partly of spreading responsibility and partly to obtain adequate working capital. For some time the new arrangement was a success, but with Frederic's increasing age he lost grip of the position in the publishing trade. On his death in 1895 the position became even worse, for the board persisted in handling details, and, though excellent men in their own particular lines, knew practically nothing of publishing and some of them were quite ignorant of finance. Matters were eventually put straight by the appointment of Mr. Waugh as managing director in 1902, a position which he held until this year, when he was elected chairman of the board, with Mr. John L. Bale as managing director.

The agency for the technical books of John Wiley and Sons was acquired in 1895, and the addition of this class of book to Chapman and Hall's list had an important influence on the future policy of the firm. It led to the establishment, just before the outbreak of the Great War, of a department for the production of similar books written by English authors. The initiation of the new venture was in the hands of Professor W. J. Lineham, who unfortunately died before the venture was completely established. His assistant, Mr. Bale, was called to war duties and there was consequently some delay in developing the scheme. However, in 1920 Mr. Bale was in full harness, and the success of his work is indicated, not only by his large list of technical books, but by the fact that he has succeeded to the managing directorship.

Seeing that the volume covers a period of a hundred years it is not surprising that events influencing the book trade generally as well as those relating to the firm's own particular history should figure largely in its pages. Readers will therefore learn much from it relating to the development of publishing as a separate business, to the formation of lending libraries such as Mudie's and Smith's, to the three-volume and six-shilling novels, to the discount versus net systems of sales, and to the introduction of the literary agent, whose function it is to get the best terms out of the publishers for the authors. Mention should also be made of the *Fortnightly Review*, founded by the firm in 1865 and presided over by a succession of brilliant authors, of whom John Morley and W. L. Courtney deserve particular mention. Originally this paper relied solely on signed articles written by men with information and views on specific subjects, but gradually the articles over a pseudonym achieved more influence and on many occasions caused considerable stir in political and literary circles. It was found that an author possessed of inside information could be induced to write if his name was suppressed, though it would have been quite impossible for personal reasons for him to have come out into the open. The experience on the *Fortnightly* affords apt evidence of the relative spheres of anonymous and personal journalism. There is much diversity of opinion on this subject, but readers may be reminded here that the MAGAZINE never encouraged unsigned articles.

EDWARD WALKER.

Structure of Typical American Oilfields. Vol. II. Cloth, octavo, 780 pages, illustrated. Price 27s. American Association of Petroleum Geologists. London: Thomas Murby and Co.

The sub-title of this book is "A Symposium on the Relation of Oil Accumulation to Structure." In this country we do not take kindly to the word "symposium" as applied to scientific discourse, probably because the dictionary has a habit of defining it in terms hardly compatible with learned doctrine, e.g. "a banquet with philosophic conversation," "drinking together," and so on. I do not know whether the American Association of Petroleum Geologists has, as a body, either regard or contempt for Greek derivations, but the word, if not actually misused, is certainly overdone in American technical circles, and while it may possibly be appropriate to the Association's earlier volume on "Salt Dome Oilfields," it is hardly as applicable to structural oil geology with which volume I, an earlier publication, and now volume II (under review) set out to deal.

Volume I comprised thirty papers constituting the programme of the 12th annual convention of the Association in 1927. This present volume contains forty papers in extension of the previous contributions. Both books are valuable publications written on precisely similar lines to the papers found in the well-known periodical bulletin. To some extent this more recent volume, as its predecessor, must make but a limited appeal to other than American oil geologists, as in every case its treatment of local structure is the last word in detail, of little concern to others than those responsible for or interested in particular American oilfield developments. It cannot be denied, however, that in these wordy accounts there lie, often only concealed with the thinnest veil of local data, principles of the utmost importance, having direct bearing on oil accumulation in many other parts of the world. The compilers of these volumes seem to have sensed this possible criticism, for F. G. Clapp has written a concluding paper intended "to summarize and correlate the results of the papers included in the two volumes," and a remarkably good summary it is too, except for his niggardly reference to lenticularity, which always seemed to me to be the weak point in his previous structural classifications. Lenticularity is a supremely important factor in many oilfields, especially in Eurasia, while in Trinidad, for instance, it is the predominant influence in oil accumulation, as it is so liable to modify or absolutely disconcert the firmer anticlinal theories as applied to many fields. Too much stress cannot be laid upon this principle, either as a conception or as an actuality. In the body of the book, however, wherever lenticularity is in evidence, individual authors give it its due, and if a separation of purely local evidence and critical structural data be made in certain papers, e.g. those dealing with the States of New York, Pennsylvania and West Virginia, much that is universally applicable may be learnt.

The volume is well illustrated with maps and diagrams and is clearly printed and well designed. There is an abstract at the head of each paper which is useful for preliminary reference, while a very full index does credit to the editorial department. Every reference library with a section on petroleum will want this and the companion volume, which together with the "salt dome" treatise constitute a monument to the progress of and service afforded by a most excellent organization. The hope may be expressed, with intended reiteration, that that ambiguous, though in other spheres often comforting, word "symposium" may be dropped from geological parlance.

H. B. MILNER.

Oilfields in the United States. By Dr. W. A. VER WIEBE. Cloth, octavo, 629 pages, illustrated. Price 30s. New York and London: McGraw-Hill.

The geology of United States oilfields has had an excellent press within the last five or six years and one must presume that the literary adsorptive capacity of the American oil geologist is very high indeed. Excluding Emmons, a real pioneer in this field in 1921, it started with the various papers published in the Bulletin of the American Association of Petroleum Geologists—that invaluable periodical—to be followed by two large volumes on the Structure of Typical American Oilfields and a specialized treatise on Salt Domes, all sponsored by the same active organization. Now comes the present book, comprising much the same material remodelled on a different plan. Since the original "Emmons" was five-sixths American fields, it looks as though a second edition of this publication, if contemplated,

would prove superfluous. Why have not the Eurasian oilfields this weighty literature: surely they too have some lessons for the world of technologists?

Professor Ver Wiebe has undoubtedly the national flair for classifying. Those who read his paper on the tectonic classification of oilfields in the United States last year (*Bull. Amer. Assoc. Pet. Geol.*, xiii, p. 409) will at once infer the main theme of this textbook if they recall his ideas there developed. Essentially he goes one further than E. G. Woodruff, pioneer of the conception of petroliferous provinces, and argues that the latter should be defined in terms of tectonic rather than geographic and genetic factors, with, admittedly, a good deal of valid reason. In illustration, he rearranges the oilfields of the United States according to eleven tectonic provinces, i.e. the Appalachian geosyncline, the Cincinnati arch, the Eastern Interior coal basin, the Michigan basin, the Western Interior coal basin, the Ouachita-Amarillo mountain, the Bend arch, the Gulf embayment, the West Texas basin, the Rocky Mountain geosyncline and the Pacific geosyncline. Such tectonic elements are subdivided into districts according to subordinate structural features. The present textbook differs from Emmon's in two main directions, the aforesaid plan of treatment and the fact that nearly a decade has elapsed since "Geology of Petroleum" appeared, during which time many new oilfields have been discovered and developed, new ideas have been born and tested, and, particularly, subsurface geology has assumed a technical status quite undreamt of in the earlier days.

Apart from the Professor's new frame-work of tectonic provinces, I have failed to find "the *considerable* (italics are the reviewer's) material which has not been printed elsewhere," though the author clearly writes as a man of much field experience and shows individuality in selection of matter and style of presentation. The stratigraphic details, however, are in the main filled in according to the gospels of U.S.G.S. and A.A.P.G. bulletins with commendable fidelity, attested by the fact that of some 230 illustrations only about a dozen—tectonic province maps—are original. Now a summation of literature, or the student's short cut to knowledge, is all very well in its way, and it may appeal to American academic circles; but where original papers are widely accessible, as they mostly are in the cases cited in this book, surely it is the better training to lead students to ultimate sources of information, to teach them to discriminate for themselves between what is material and what is detail, apart from that desirable inculcation of respect for priority and tradition, than to spoon-feed them with chosen essences whose culture simply encourages laziness and breeds a stubborn narrowness of outlook.

The author writes primarily for the student of oil geology, the professional geologist and executive men in the industry, for whom he provides a book that is "complete and up to date." The trouble is, however, that it is complete as far as it goes and up to the date of February, 1930. At the present rate of discovery of new fields in America it will be out of date in two or three years' time and, save periodic new editions, back the student, professional geologist and executive must needs go to the original papers to learn how much has been accomplished in the interim and how much of the old learning must be revised in terms of the new.

In conclusion, I can assure Professor Ver Wiebe, that the Bulletin he quotes so often does, in fact, penetrate to oilfields all over the world, and it is by no means unknown to British and foreign oilfield executives, both in capitals and "in the blue." I find it difficult, however, to recommend to British students of petroleum geology any book which tends, however innocently, to discourage them from constant appeal to original literature, though doubtless there are many others who, requiring undelayed information on a geological point concerning an American oilfield, would welcome access to this rather uninspiring volume.

H. B. Milner.

Elektrische Bodenforschung. By Dr. Walther Heine. Vol. 8 of Sammlung geophysikalischer Scriften, edited by Dr. Carl Mainka. Paper covers. 222 pages, illustrated. Price 18 marks. Berlin: Gebrüder Borntraeger.

This work forms a very comprehensive theoretical account of the applied science of electrical prospecting, which was largely developed in Sweden, France and Germany, but has subsequently extended its field of operation throughout the world. The theory, apparatus and methods of electrical prospecting are highly specialized, so that information relating to them is difficult to obtain outside the scattered articles published

in scientific and technical journals. In the book reviewed, this information is rendered available in a compact form and presented in an ordered succession. Various practical difficulties are thoroughly discussed and fairly presented. Amongst these may be mentioned specially the effects of phase relations in the use of alternating current in the ground, and the effects of topography on the electric current and electromagnetic field distribution. Also the various disturbances caused by the currents flowing in the cables are analysed.

Previous to the appearance of this book, many of the difficulties here discussed were slurred over by most writers on the subject, and the application of the principles in practice was thereby given a spurious appearance of simplicity and freedom from scientific control which rendered it liable to abuse and misuse at the hands of unskilled operators. As a result, much slipshod field work was accomplished under conditions definitely detrimental to correct control and interpretation of the observations, with the inevitable consequences of wrong deductions and partial distrust of the methods on the part of mining personnel. The book by Heine has gone far towards instituting a more rigorous examination of the whole procedure of electrical prospecting, and inaugurating a campaign of frank discussion and intensive research which is still in progress, and the results of which are apparent in the excellent articles relating to this subject which are now appearing in the relevant periodicals.

As an introduction to these more specialized articles, Heine's book can be thoroughly recommended. It can hardly, however, be regarded as more than an introduction to a subject which has extensive ramifications both in theory and in practical application to prospecting problems of divers conditions and scope. In view of the rapid development in the subject, and the steady output of specialized articles relating to it, the work has already become incomplete, and certain methods which are now obsolete are unduly stressed, whilst others of more recent development are scarcely mentioned. Nevertheless, a valuable mass of fundamental theory from which all methods must borrow and to which constant reference is necessary is presented in the book, which will always remain a standard reference work in this special field.

H. Shaw and E. Lancaster-Jones.

Textbook of Geology. Part 1 : Physical Geology. By the late Louis Pirsson. Third Edition, revised by W. M. Agar, A. M. Bateman, C. O. Dunbar, R. F. Flint, A. Knopf, and C. R. Longwell (editor). Cloth, octavo, 488 pages, illustrated. Price 18s. 6d. New York: John Wiley & Sons; London: Chapman and Hall.

Of all American textbooks of general geology, the work of Pirsson and Schuchert is probably the best known and most widely appreciated. It will be recalled that there are two volumes, parts 1 and 2, the former by the late Professor Pirsson on " Physical Geology ", the latter by Professor Schuchert on " Historical Geology " Part 1 has already gone through two editions and the present volume constitutes the third, though it is, in fact, a very different " Pirsson " from the original, as no less than six revisers have been engaged on its preparation, and some quite drastic changes have been wrought.

In the former editions of part 1, a twofold subdivision into Dynamical and Structural Geology was adopted, resulting in a certain rigidity of treatment of the subject-matter which pure geology, as such, hardly allows. The science may permit of systematic description in certain of its branches, but system can be much overdone when discussing its principles. Yet it is comparatively few American writers who can break away from that instinctive desire to organize, whether it be men or materials, matters concrete or abstract, so that it is rather refreshing to find a collective work such as this free from any undue tendency to pigeon-hole data. The new edition is certainly less of a catalogue of facts, more, perhaps, a descriptive treatise than a textbook, and it makes surprisingly easy reading considering that seven individual styles of expression, including the original author, are involved. This says much for competent editing.

A first glance through the book reveals, to those who know the former volumes, two important changes for the better. The small type paragraphs are now dispensed with entirely in the text (excluding reading references), and the illustrations, though not much greater in number, are in several instances materially improved. Some of these are particularly fine, for example, figs. 74, 165, and the frontispiece. The most noteworthy changes as far as subject-matter is concerned are as follows :—The intro-

ductory chapter has been re-written. A new chapter (2), entitled " A General View of the Earth," deals with its larger features and relationships. The discussion of stream erosion is much fuller, while the erosion cycle under different climatic conditions is now well described. Metamorphism, and not merely metamorphic rocks, finds ample definition according to modern conceptions, while readers interested in geomorphology will find a very attractive new section on " Land-forms," in which topographic evolution, as dependent on fundamental geology, is well explained and illustrated. The chapter on " Ore Deposits " has been shortened and simplified with advantage, the Appendix on " Minerals " has been improved, also another tabular one added on " Chronology of Earth History," not an impressive diagram, while the coloured geological map of North America included with the older editions is now omitted.

H. B. MILNER.

Elements of Optical Mineralogy. By N. H. and A. N. WINCHELL. Part III. Determinative Tables. 2nd edition, cloth, octavo, 204 pages, with coloured chart and two diagrams. Price 22s. 6d. London : Chapman and Hall.

Parts I and II of the " Elements of Optical Mineralogy " were described by the present reviewer in the MAGAZINE of March and December, 1928, where it was stated that these two well-known volumes had been entirely rewritten by A. N. Winchell, Professor of Mineralogy and Petrology, University of Wisconsin, thus ensuring they would for a future period of years remain, as in the past, standard text-books on this important subject.

This second edition of Part III, which is much enlarged, summarizes in a series of most useful tables all the available data on the optical properties of minerals. The tables are set out in a form which enables thin sections of minerals, under the petrological microscope, to be determined accurately, but the application of the determinative tables is possible only to those who are familiar with optical principles and the methods of investigation described in Parts I and II. Part III is definitely a reference book of little use to the elementary student, but invaluable to those who have the requisite knowledge.

Table I, which deals with opaque minerals, is the least satisfactory in the volume. During the last few years very notable progress, of extreme importance to the mining geologist, has been made in the microscopic study of polished surfaces of opaque ore minerals by reflected light, and by reflected polarized light, but although it is clear that the author is aware of this progress he has left this important branch of optical mineralogy almost untouched, except by references to books on mineragraphy. A more descriptive title for Part III would have been " Determinative Tables of Non-opaque Minerals."

Table II, occupying pages 11 to 75, is based on the birefringence of minerals and is the most complete table hitherto published on one of the most useful and reliable methods of investigation. It is unfortunate that the coloured chart illustrating birefringence is reproduced in colours that have little resemblance to those seen with the quartz wedge. In size, arrangement, and colours, the chart is strikingly similar to that published by Michel Lévy many years ago, before the present improved colour process had achieved so high a standard.

Table III is based on the colour and pleochroism by transmitted light and is so arranged that the examined mineral can frequently be placed quickly amongst a comparatively small number of possible minerals. Table IV consists of an arrangement of isotropic minerals classified according to their refractive indices, and Table IVB a similar arrangement of anisotropic minerals ; one useful column in both tables shows, by means of vertical lines, all known variations in refringence.

For the determination of powdered minerals in immersion liquids, Table V will be found particularly helpful. Plate II, based on refringence and birefringence, has been prepared, as the author states, along lines suggested by Professors C. O. Swanson and R. H. B. Jones. It is an extremely useful diagram which, almost at a glance, enables the examined mineral to be placed in a small group of possible minerals. The stereographic plot of Wulff, Plate III, is a device for plotting and measuring angles in a stereographic position ; it has been purposely printed on translucent paper so as to permit reproduction of any number of copies for use on the universal stage.

The volume, in some respects similar to Larsen's well-known book " The Microscopic Determination of Non-opaque Minerals," now unfortunately out of print, has the advantage

over the latter in that the tables are not arranged under uniaxial and biaxial minerals, for frequently it is difficult, and sometimes impossible, in thin sections to determine whether a mineral is uniaxial or biaxial. This Part III contains the most complete and useful series of determinative tables on the optical properties of non-opaque minerals that have hitherto been published, and will probably be considered a standard reference work for some future years. The publishers have well maintained the high standard that one has learnt to associate with their names.

WILLIAM R. JONES.

☛ Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 724, Salisbury House, London, E.C.2.

LETTERS TO THE EDITOR

The Education of the Engineer

SIR,—The letters on this subject initiated by Mr. J. A. Agnew have given rise to a considerable amount of discussion among mining men and he is not far wrong in his contention that, notwithstanding the first-class technical education and training a young man may obtain at the Royal or any other English school of mines, he is only at the "bottom rung of the ladder" when he has finished his course. Mr. Agnew, who hails from Australia, appreciates the R.S.M. training, but his experience has shown him that American and Colonial students have usually done some practical work on a mining field which the average English student has not, and are therefore the sooner fitted to shoulder responsibilities.

The budding engineer, after winning his degree, is, except in a few instances, without any really useful practical knowledge of the world, and of, for instance, the tact required for the handling of employees, either white or coloured. The writer, having had a lengthy and varied experience in several countries and having had post-graduate students sent to serve under him in mines abroad, is convinced that all prospective mining students should at the age of 17 or 18 years and *before* entering on a four years' course at a school of mines submit themselves to an all-round practical apprenticeship of one or even two years in the several departments of selected mining concerns. Such experience would enable them to understand better the lectures they attend, and to absorb the teachings received at the capable hands of the professors and demonstrators.

The schools of mines courses should not be interlarded with too much so-called practical work, which should be done by the student both before and after his school of mines training, as well as during the vacations, which latter should for the greater part be spent in visiting mines and metallurgical works both at home and abroad, with introductions from the schools. It would surely not be difficult for the authorities of the different schools of mines to arrange for such pre-graduate courses, and even for the student to receive a small wage as encouragement for such services as he might render, the arrangements being under the control of the school authorities. It would, of course, be advantageous for a student to have a short post-graduate course before taking a salaried post, but a pre-graduate practical course is in the writer's opinion of far greater importance, in that it would make the student so much more interested in his technical studies of the subjects of which he would already have had a good smattering.

ARTHUR J. BENSUSAN.

Royal Societies Club.
July 22.

SIR,—The letter of Mr. Agnew in the May issue of the MAGAZINE seems to call for comment from a R.S.M. man in Canada. Whilst there is some truth in the statement that some R.S.M. men expect a mine manager's job after about five minutes' work underground, it is, I submit, due more to ignorance of the world than to any conceit on their part. One sees the same in Canada and the U.S.A., where young graduate engineers who have not had to rub shoulders with the industrial world receive a rude jolt when they find themselves mucking underground. I have seen R.S.M. boys drilling and mucking for months on end in Canada and this I think speaks for itself about the idea of manual work being considered *infra dig.*

As for one having to go to America for mining engineers to fill responsible posts, this is absolutely incomprehensible to me and seems to be due to faulty staff work. There are surely as good mining engineers trained in England as in the U.S.A. and

the only reason I can imagine for not finding them is that either they were unaware of the vacancies or that the remuneration offered was not a sufficient inducement.

H. BLACKMAN.

Montreal.
June 25.

Uranium in Cornwall

SIR,—I have read with much interest the article on "Uranium in Cornwall" which appeared in the April issue. In recent years I have had the opportunity of examining many old records of West Country mines and, in addition, have examined many of the old mine dumps in Cornwall. The list of mines mentioned by the author where uranium minerals have been found is very comprehensive, but the following might be added:—

Mine.	*Locality.*
Wheal Pink	Gwennap.
Wheal Moyle	Gwennap.
Wheal Damsel	Gwennap.
Drannack	Gwinear.
Wheal Drewlas	Gwinear.
Cliff Downs	St. Agnes.
Wheal Hender	Crowan.

WM. A. EDWARDS.

Valparaiso.
June 10.

NEWS LETTERS

JOHANNESBURG

July 10.

Gold Discoveries N.E. of Springs.—Banket reefs carrying high gold values have been discovered on farms situated about 20 to 25 miles north-east of the township of Springs. The most important of these occurrences is on the farm Moabsvelden, one of the properties of the New East Rand Syndicate. Here, according to a report made by the Syndicate's consulting engineer, Mr. E. H. A. Cohen, a solid banket reef, 15 ft. wide and assaying over all 7½ dwt. to the ton, has been exposed. The strike is N.W. and S.E., and the dip apparently will be S.S.W. The strike of the formation at Welgelegen, another of the New East Rand Syndicate's properties, Mr. Cohen states, is north and south, the dip varying from 13° to 15° to the east. At the bore-hole site where sinking for water had taken place, is a circular shaft approximately 12 ft. deep, from which samples taken recently gave very satisfactory values. The shaft is now being sunk to a lower depth to prove the width and value of the reef. North of the borehole at 246 yds. there is a parallel formation which can be traced considerably over a mile north and south, and in a trench approximately 10 by 4 by 30 ft. this body is exposed resting on a well-defined footwall over a regular dip of 15° to the east. Starting from the surface at a few inches wide, it increases at the face of the trench (on the dip) to over 4 ft., and appears to be still increasing in width. Mr. Cohen attaches great importance to these discoveries. He states that several assay results of samples taken by Mr. S. J. Lett, himself, and others are of such an extremely favourable nature that they afford reliable evidence of the existence of a series of reefs of a highly payable nature extending for several miles.

Dump Residues Process.—It is claimed for the process which has been acquired by the Dump Residues, Ltd., that its main feature is its simplicity in operation, the gold content of the sand under treatment being dissolved by the use of a special solvent, which is pumped on to the dump as it stands in place and is allowed to soak in. As dump sand can only hold from 15 to 20% of moisture, this solution soon makes its appearance at the foot of the dump, carrying with it the gold that has been dissolved during its passage through the sands. This solution is caught in trenches at the foot of the dump—the trenches are cut through the soil to the bedrock—and the solution is then freed from its gold content by a special precipitant, which does not destroy the solvent, and is then returned to the dump to treat a further portion of sand. The materials used in the process cost very little and on a conservative basis should not exceed 4d. per ton inclusive of overhead charges.

Postmasburg Manganese.—It is expected that the official opening of the railway which connects the Postmasburg manganese fields with the main line will take place in August or September next, by which time the Manganese Corporation's power station and the loading plant at Durban will be ready and it can settle down to shipment on a big scale. The corporation is starting to ship some ore on a small scale right away. Labour is plentiful at the company's mines, and at

the present time about 2,000 Europeans and natives are employed there. Mr. F. N. Pickett, the chairman of the Corporation, who is paying another visit to South Africa, states that the corporation's standard high-grade ore, going about 50% metallic manganese, is equal to the best so-called "oriental mixture", the highest grade of blended ore now on the market, whose constituents have to be drawn from different sources. The corporation will also be producing a "super" grade going 52%, or better, which has no counterpart in metallurgical ores from any other part of the world. The 78,000 tons of high-grade ore in stock has been sold at satisfactory prices. The company is now negotiating with the Government for a special railway rate for its lower-grade ore for which a demand has risen in connexion with the development of a completely new process of steel manufacture called the Thomas process. The corporation has been offered a very considerable interest in this business, provided it can supply the manganese ore at a competitive price.

Radio-active Minerals in S.W. Africa.—Small pieces of pitchblende have been found in the various alluvial deposits of South-West Africa, but upon investigation they were found to be only "float". Blobs of galena are frequently met with in the crystalline limestones, but no body of that metal, or of blende is met with. Mr. L. J. Spencer, the Mineral Curator of the British Museum, who came out with the scientists some months ago, found that the zinc which occurs at the lower ends of the Tsumeb Mine (Otavi Mining Company) was radio-active.

Transvaal Phosphates.—One of the Transvaal's oldest prospectors has discovered deposits of phosphates in the Leydsdorp district which are said to be unique as far as South Africa is concerned. The occurrences are reported to be fairly extensive and consist of apatite, or a similar mineral to that which has been worked at Bandoliers Kop during the last two years. A drill has been despatched for the purpose of testing the occurrences at depth.

An Appeal to the League of Nations.—The Kaoko Veld Territory of South-West Africa was formerly held by a German company styled the Kaoko Veld Land and Mining Company. Under its charter the company held sovereign rights over its territory. At the conclusion of the war the ground reverted to the Administration of South-West Africa, excepting for mining areas. As the company had not complied with the regulations laid down by the mining authority, steps were being taken to cause these mining areas to revert to the Government, when the Berlin company appealed to the League of Nations for maintenance of their rights. The decision has not yet been published.

Northern Rhodesian Coal.—Under this heading last month reference was made to the position of Hot Springs as being over one hundred miles "due east of Broken Hill." This should have read "due west of Broken Hill."

BRISBANE

June 17.

The Coal Stoppage Over.—The stoppage of work at the associated coal mines on the northern fields of New South Wales, after an idleness of over fifteen months, has at length come to an end. The miners have gone back to work on what is known as the compromise terms—those offered to them in November last. Under the conditions stipulated originally, the owners were ready to work their mines if the men agreed to a reduction of 1s. a ton in their pay, on the understanding that a further reduction in the cost of production, so as to bring such cost down by a total of 5s. a ton, should be contributed in different proportions by the owners, the State Government, and the Federal Government. The obstinate refusal of the men to accept any lowering of wages has led to the long-drawn-out, costly, and hopeless struggle that has now ended. The November offer was for the men's share of the reduction to be 9d. instead of 1s. per ton. Although this proposal was at the time accepted by representatives of the miners, it was turned down by large majorities when submitted to the various labour unions concerned. Now, after a further six months of idleness, the men have resumed work on this basis. A reduction in the selling price of coal has already been announced by the associated mine-owners, and the unassociated mines—nearly all of which have remained open on the old working conditions—are following suit. The State Government is reducing the charges on coal for railage freight, etc., and the full amount of reduction, including 1s. a ton to be contributed by the mine-owners and the

9d. agreed to in wages, will lessen the local selling price by 3s. 3d. a ton, and the export price by 4s. 3d. The new local price will be 22s. 2½d. a ton, free alongside cranes, for the best screened Maitland coal, and 16s. 8½d. for small Maitland coal. The old rates were 25s. for screened and 19s. 6d. for small coal. The direct loss in production of coal through the stoppage, which involved all the principal coal mines of the State, is estimated at £3,000,000, but what the loss altogether has been through interference with other industries, as well as that of the trade in coal that has gone elsewhere, it is impossible to calculate. The coal trade of the adjoining State of Queensland, which had benefited largely by the cessation of output in the south, has already dropped off greatly, and must continue to do so unless the mine-owners here find a way of reducing the costs of production, as has now been done in New South Wales.

Position at Mount Isa.—The most important news of the past month relating to Mount Isa has been an official announcement that the Queensland Government had guaranteed a Bank overdraft of the Mount Isa Mines, Ltd., to the limit of £500,000, which has tided that company over a critical period, and thus saved at least a temporary stoppage at the mines. As was expected, the responsibility of the State Government, thanks to the satisfactory subscription of the company's debentures which followed, has already been largely reduced, and may in the end practically amount to nothing. The Mount Isa Company—or rather the Mining Trust, which controls it—has been faced with a position, the result of a combination of circumstances, that is quite exceptional. It is probable that not only the financial situation abroad, mentioned by the Premier of the State (Mr. A. E. Moore) in announcing the Government's action, but also the steady fall that has taken place in the value of lead, silver, and zinc, which will be the products of the mine, contributed to the causes of the late situation. The original estimate of profits was based on the price of lead at £20 a ton, which was lower than the quotation when that estimate was made but considerably higher than it is now. At the mines, too, the company has of late been hindered in its operations by floods that interfered with transport, and likewise by encountering underground an unexpectedly large quantity of water. One result of these occurrences has been to make it impossible for productive operations to be commenced in August, as originally planned. When this became evident, it was thought that there would not be any output of minerals, and consequently no income, till the end of this year. We have now, however, been told by Mr. Moore that it is expected that output will begin in October with the treatment of 750 tons of ore a day, and that early in next year this quantity should be increased to the intended initial capacity of 2,000 tons daily. It is also stated that the life of the mine is estimated by experts to be 50 years. According to a circular from the Mining Trust, which has just come to hand, with this output and even with the price of lead now ruling (about £18 a ton), it is estimated that an annual profit will be made of £665,000, without taking zinc into account.

Activities at the Mine.—From the reports for April of the District Inspector of Mines and the Cloncurry Mining Warden, it is learned that operations underground at the Mount Isa mines were then still being hampered by excessive water; while a further set-back was met with during that month through the breakdown, on the 21st, of one of the air-compressors. Operations, however, had been resumed at the 300 ft. level in Doherty's shaft, on the Black Rock lode, and two new Ingersoll-Rand air-compressors had been installed at Lawlor's on the Rio Grande lode, where sinking was to be restarted on May 6. After a temporary stoppage, driving in the upper levels at Davidson's shaft (Black Star lode) had been recommenced; also the sinking of 46 shaft, which had reached a depth of 320 ft. In the diamond drilling campaign, on the Black Star lode No. 2 B. borehole was finished at 1,344 ft. In this bore, which passed through the ore-body from 993 ft. to 1,259 ft., the zinc contents were very pronounced towards the footwall. Core assay gave average results—from 1,239 ft. to 1,244 ft., of 10% of lead, 11% of zinc, and 4·8 oz. of silver to the ton; while from 1,284 ft. to 1,289 ft. they showed 8·1% lead and 13·9% of zinc, with 6·8 oz. of silver to the ton.

Decreased Mineral Output.—The low price ruling for the industrial metals is having a serious effect on Queensland's chief mineral belt—that of Herberton and Chillagoe, in the hinterland of the northern port of Cairns. Last month there was only one tin crushing—that from the still highly

productive Great Northern mine, which lately celebrated its jubilee. Following on the suspension of work by the Whitworth Mining and Finance Company, a recently formed local company, the Una, which has been working at Watsonville, near Herberton, has been compelled to greatly curtail operations. In spite of the reduced mineral output, however, there is still a fair amount of activity amongst the individual miners, who prefer to continue at work and store their ore in expectation of improved markets, rather than be idle. There are others, with the true mining spirit, who say that a "show" that will give "tucker" is better than no work, and who sell their product at a low figure in order to keep the wolf from the door.

Broken Hill Mines Closing.—Another, and more serious, result of the state of the metal markets, is that one mine at Broken Hill—the British, owned by Broken Hill North, Ltd.—is closing down on June 28, and that, unless prices show a substantial improvement, all the mines on the Barrier are expected to cease operations by the end of this month except the North Mine of North Broken Hill, the Central mine of Sulphide Corporation, the Zinc Corporation, and Broken Hill South. Work has already been suspended for some time at the Junction and Pinnacles mines. The leading companies mentioned as not likely to close are in a better position to overcome periods of low metal prices, as they are not wholly dependent for revenue on mining and treatment operations, and possess larger ore-bodies and reserves.

Relieving Unemployment.—In connection with a scheme for relieving unemployment, the Federal Government are appropriating £100,000 to provide work in other occupations for excess miners on all the Commonwealth coalfields. With the same object in view, and in the hope of finding fresh deposits of gold, the Government of New South Wales is sending out gold prospecting parties to fossick for that metal throughout the State. Individual parties and syndicates engaged in a similar search are also to be helped.

New Gold Discovery.—A recently discovered gold find at Edjudina, Western Australia, has been visited by a well-known and experienced prospector, who had found gold in the same locality some years ago. He reports that the gold now discovered can be traced for a length of 200 ft., that there is a well-defined quartz reef, which where opened up is about 4 ft. wide, and that samples have assayed up to 2½ oz. of gold per ton.

IPOH

July 17.

Malaya and the Tin Position.—On the Kinta mining field the most anxious question is still "can any good thing come out of the T.P.A?" The gravity of the present situation is widely realized, and there is great urgency now to select a policy that will protect the best interests of all genuine participants in the tin-mining industry. The problem is not simple nor is there only one problem. First there is to be avoided anything resembling a stampede in the industry with widespread stoppages of work and discharge of labour for whom no other employment could be found. Next there is need to prevent the irreparable loss and waste that will result if, in any ill-judged scramble for survival, the ore which is the principal asset of the industry is thrown away at a price far below its reasonable value. In this it must be kept very clearly in view that the total proved ore reserves are not unlimited, indeed most of the properties are fully explored, and their resources are definitely known, so that it can be said that at the normal rate of working the known values will be exhausted within ten, fifteen, or twenty years as the case may be. The folly of wasting these definitely limited resources should need no exposition.

To keep mines in some measure organized, and sufficient labour employed, however, will require some production of ore, and some proportion of normal output must be determined and permitted to suit various conditions and scales of operation. The returns for May, 1930, show that 54% of the output was from mines owned and worked by Europeans, 10% from mines owned by Europeans and sublet to Chinese miners and 36% from mines owned and worked by Chinese. Of the total over 40% was from dredging, leaving 60% won by other methods employing a large proportion of the labour in the industry and requiring very careful consideration and treatment to carry these producers over the present period of emergency. Admitting that overcapitalized, extravagantly worked, and indeed any unsound undertakings must and should be reorganized or abandoned there will remain for a time many local and other

companies requiring well-considered assistance during the present emergency. The dredges, of which 103 were working in April, are in quite a different situation from the other types of equipment, and it is certainly their high rate of output that has done most to bring about the present crisis. In some of the open-cast mines the inefficient and uneconomical use of recently installed electrical equipment is aggravating the difficulties; and the Hydro-Electric company's system of charging consumers at the rate of their peak load over a very short period is a cause of widespread dissatisfaction.

Various palliatives and remedies have been suggested. The stoppage of production for not less than two months should give time for decision as to other measures. At the end of any period of stoppage regulation of output must follow, but the effect of regulation may be too slow unless a proportion of even the restricted output can be kept off the market, and to provide for this it has been suggested that producers should combine to take up and to hold certain agreed proportions of tin produced, as circumstances may require, and that all such tin should be held in security for advances, and should not be sold at anything under £225 per ton. This figure would allow for the costs of carrying the metal and financing the operations.

Benefits in the Future.—One assured consequence of the present crisis will be the great improvement in economy and efficiency of working throughout the field. The methods in common use in the majority of open-cast mines have been almost traditional, and there is no doubt that both in reduction of working costs and in efficiency of tin saving, but especially the former, there is room for material improvements. Except on installations having their electrical equipment under European trained supervision the advantages of electric power have not been fully realized, and many common practices in working tend to raise the cost of such power far above what it should be. Another feature against economy and efficiency is the small size of many of the areas into which mining land is divided, making advantageous lay-out, disposal of tailings, and complete extraction of ore, all alike difficult or impossible. Consolidation of adjoining small areas may give a new lease of life to some parts of the field.

A good practical knowledge of local and general geological features is to be expected of those who advise mining companies on the value and development of their properties. It is notorious that such knowledge is often conspicuously absent, with very deplorable consequences; but attention is being drawn to this side of the business also, and it is up to those who can to learn now so that disastrous errors may be avoided in the future.

VANCOUVER

July 10.

Portland Canal.—S. G. Blaylock, vice-president and general manager for Consolidated Mining and Smelting Company of Canada has announced that development at the Big Missouri mine has reached a stage where the erection of a mill large enough to treat the whole of the ore won in development is justified, that construction will be started immediately, and that it is expected the mill will be ready for operation before the end of this year. The mill will serve as a guide as to milling, the practise for the particular ore, and as to what will be needed when the time is ripe for its further extension. The mine is being developed by Buena Vista Mining Company, 53% of the stock of which is held by Consolidated and 47% by Big Missouri Mining Company. The funds for the development and equipment are being provided by Consolidated, which receives in exchange first mortgage bonds of the company. Though no official statement has been made as to the amount of ore developed, it is persistently rumored that ore to the gross value of more than $10,000,000 has been indicated and there is the probability that this will be markedly increased by further development. Assays show values, which are chiefly in gold, to be exceedingly erratic, rendering it impossible to make anything approaching a close estimate of the value of the ore actually developed, and still more impossible to estimate closely the ore indicated. Consolidated has resumed development of George and Tide Lake groups. Premier Gold Mining Company has paid the customary dividend of 6%, covering operations for the second quarter of this year. Despite the unpromising results of the development of the Silverado group, as detailed in the company's annual report for 1929, the company has resumed development on this property, possibly in the hope of retrieving from ore between the 145 ft. level and the surface the money

that has been expended on the property. The Prosperity mine continues to develop well, and at the same time is proving a profitable producer, though, owing to the fall in the price of silver, nothing like as profitable as was hoped when the company took a 76% interest in the property, some two years ago. The 1,814 tons shipped during May brought a gross smelter return of $60,498·32 and resulted in a net profit of $31,326·88. Since the mine was brought to production in last November 8,853 tons has been shipped; this has brought a gross smelter return of $288,583·46 and has resulted in a net profit of $124,569·29.

the condition of the lead and zinc market. The mill is being operated at capacity, and despite the fact that most of the zinc concentrate produced is being stored, is making a small profit for the corporation. The reserve is being increased each month and now amounts to some 500,000 tons, running between 30 and 35% of combined lead and zinc and 3 to 4 oz. of silver per ton. The West Monarch shoot, which lies flat, has thickened from 23 up to 34 ft., and the reserve can be rapidly increased at any time that metal-market conditions warrant.

Britannia Beach.—Britannia Mining and Smelting Company has made some changes

The Britannia Mill at Britannia Beach, B.C.

The Kootenays.—Consolidated Mining and Smelting Company of Canada has paid the customary dividend of 5% and bonus of $5 per share, covering operations for the first half of this year. The disbursement amounted to $3,187,810, which brings the company's total disbursement to date up to $39,111,435. In announcing the dividend, Mr. J. J. Warren, president of the company, said that there was some accumulation of unsold zinc at the smelter, but only normal working stocks of other metals. Operations at all properties and at the smelter are proceeding satisfactorily. Base Metals Mines Corporation has decided not to increase the capacity of the mill to 500 tons daily until there is some improvement in in its personnel preparatory to bringing the Holden mine, near Chelan, in the State of Washington, to production. Mr. J. I. Moore, Jr., who has been mine superintendent at Britannia for eight years, has been made managing superintendent of the Holden mine, and is succeeded at Britannia by Mr. C. V. Brennan, who has been supervising the development of the Holden mine, and all other explorative work for the company. With the general manager for the company, Mr. C. P. Browning, Mr. Brennan will continue also to supervise the company's new explorative work. Mr. A. C. Munro, who has had charge of the Britannia mill for many years, and who has introduced several new devices to increase capacity

without appreciable sacrifice to recovery, has been made manager of mills for the company. Either this or next year a mill will be erected at the Holden mine, which gives promise of being developed into another large copper-gold producer.

Victoria.—The coal output of British Columbia for the first half of this year will fall some 200,000 tons, or about 18%, short of the output for the corresponding period of 1929. The Vancouver Island mines are being operated at about half time, and operators report that orders on their books do not justify the employment of as many men as now are employed.

TORONTO

July 18.

Porcupine.—During June the gold mines of this area produced bullion to the value of $1,347,139 as compared with $1,545,110 in the preceding month. Hollinger Consolidated reports a higher operating profit for the quarter ending June 30 than for the previous quarter, due to an improvement in the grade of ore, which during the first six months averaged approximately $6·55. An operating profit during the first six months of $1,914,739 is reported, leaving a net profit after meeting dividend requirements of $315,739. The tonnage supplied to the mill is drawn from the known area of mineralization in the upper levels, the ore reserves being well maintained. The new mill of the Dome Mines of 1,500 tons capacity now in course of construction is expected to go into operation in October. The ore now in sight exceeds $1,750,000 and is being steadily increased so that when production is again commenced they will be nearly four years ahead of mill requirements. The McIntyre has decided on the erection of a new mill with a capacity of 2,000 tons which will be located near No. 11 shaft where the foundations are already laid. The development being conducted at the upper levels from the No. 11 shaft, which is now down 4,150 ft., is largely adding to the ore reserves. For the three months ending June the gross income was $1,148,856, and net earnings before depreciation amounted to $484,035. An official statement of the production of the Vipond during the quarter ending June 30 gives the value of the output at $246,200 from the treatment of 28,709 tons of ore which compares with $211,800 from 28,336 tons milled during the previous quarter. The position of the mine has been greatly improved by the opening up of important veins coming in from the Hollinger property adjoining, and the results of the developments at the 1,000 ft. level. At the Coniaurum production is being maintained at the rate of about $2,000 per day. The Goldale vein, the known length of which was 180 ft. on the 500 ft. level, has been proved up to a length of 400 ft., carrying $8 ore. The downward continuation of this vein has been encountered at the 1,000 ft. level. A winze is being put down from the 2,000 to the 3,000 ft. level and levels will be established at the latter horizon, and at 2,500 ft.

Kirkland Lake.—The June output of the Kirkland Lake gold mines from the treatment of 99,868 tons of ore was valued at $1,552,921, as compared with $1,349,969 produced from 99,261 tons of ore in the preceding month. A new high record for production is being established for Lake Shore, due to a better grade of ore being milled. The present rate of production is about $800,000 monthly. The mill is handling about 1,350 tons of ore daily, and millheads are more than $20 a ton. By August 1 the new mill addition is expected to bring the capacity up to 2,000 tons per day. By the installation of a ball-mill the Wright -Hargreaves is planning to increase its production by at least 20%. A vein coming in from the Lake Shore 6 ft. in width, and carrying average values of $14 to the ton, has been opened up on the 1,750 ft. level, a rise on this ore is being started. The Bunker-Hill Extension, which has taken over the Tough-Oakes Burnside property on option, is preparing to make a complete survey of the mine before undertaking definite plans for exploration. Preliminary work resulted in a surface discovery near the Sylvanite boundary, where a showing gave assays of $30. Production at the Sylvanite during the past three months has reached a new high level. During the past year 75,408 tons of ore were treated at the mill with a production of $690,400. Progress is being made with the development programme and a better grade of ore is being opened up. A promising vein has been cut on the 1,700 ft. level, and the shaft will be put down some distance further. Further important discoveries at depth have been made at the Kirkland Lake mine. At the 3,875 ft. level a good vein of ore

725 ft. long and 28 ft. wide has been encountered. The production of bullion has latterly been at the rate of about $2,500 per day. The shaft is now down to the 4,300 ft. level, making this mine the deepest in Canada. Work has been resumed at the Telluride and the mill will be put in operation as soon as power can be secured from the transmission line now being built to the property. Improved mineral conditions are reported with recent work at the Barry-Hollinger where sinking operations are under way from the 1,625 ft. level. The winze, which has reached a depth of 1,720 ft., is passing through high-grade ore showing a width of 4 ft., which will be opened up as soon as the sinking is completed.

Sudbury District.—International Nickel is making good headway with its programme of expansion, and it is expected that in a few weeks the mill and smelter will be handling over 250,000 tons of ore per month. Five out of the eight converters installed in the new smelter, each with a capacity of 1,000 tons of ore a day, are operating. It is planned to rebuild parts of the old smelter, and adopt it to the making of a product to be treated at Port Colbourne, most of the copper being previously taken off in the new smelter and shipped to the copper refinery at Copper Cliff. The flotation concentration mill is now in its final construction stage, and it is expected that the treatment of 10,000 tons of ore will produce 5,000 tons of concentrates which will go direct to the smelter. The company has contracted with the Ontario Hydro Electric Power Commission for a supply of 16,000 h.p., to be delivered when the new development of the Abitibi River is completed. During the quarter ending June the smelter of Falconbridge Nickel Mines treated a total of 25,378 tons of ore, the matte produced containing 1,896,823 lb. of nickel and 477,150 lb. of copper. Production during June was somewhat curtailed owing to a temporary shutdown caused by the shortage of power. Underground developments continue to be satisfactory, commercial ore being stated to continue from 700 to 800 ft. below the 1,000 ft. level, adding large tonnages to formerly reported ore reserves. The Treadwell Yukon has completed the sinking of No. 2 shaft at the Errington mine below the 1,500 ft. level, where a station is being cut. Work on the 500 ft. level has continued to add to the tonnage of ore, conditions indicating that there is about 1,200,000 tons of ore in each 100 vertical feet. Exploration work is being carried on at the property of the Junior Frood Mines, located north of the Frood, and at the Lockerby property recently acquired by the Bunker Hill Extension.

Rouyn.—The output of the Noranda will shortly be increased by the completion of a concentrator with a capacity of 500 tons daily. A record has been attained of 2,000,000 lb. or about 1,000 tons of copper per week. The erection of the new stack is making good progress which, in addition to meeting present requirements, will provide for future smelter expansion. The scope of development at lower levels is gradually increasing. The two main shafts now established to 1,500 ft. in depth will permit of aggressive work in that horizon between the 975 and 1,500 ft. levels. The equipment now at Noranda is good for a maximum of about 3,000 tons of ore daily, the smelter being able to handle close to 2,000 tons of high-grade ore, in addition to 1,000 tons of concentrates. Rapid progress is being made with the construction of the mill at the Abana, where part of the machinery has been installed, and it is expected to be ready for operation by October. The ore reserves are sufficient to keep the mill in continuous operation, being estimated at 937,900 tons. Lateral work on the three lower levels of the Waite-Montgomery has shown the ore-body to be of considerably higher grade than at first supposed, the grade of ore being about 7% copper. The company has discontinued shipping ore to the smelter and is concentrating on development. The new mill of the Granada has gone into operation, treating 35 tons a day which will gradually be increased. Mine developments and ore indications are well maintained, with sufficient ore available for mill feed for a considerable time. At the Newbec a winze is being put down from the 250 to the 375 ft. level, from which levels will be run east and west. Stoping is being continued on two levels, and mineralization is showing some slight improvements.

Patricia District.—The Mill of the Howey, which is the only producing mine in this district, is treating about 500 tons daily, the ore is low grade, and in order to make operations profitable, it is planned to increase the capacity of the mill to 1,000 tons, the success of the enterprise being apparently dependent upon increasing

the scale of operations. Development at the Central Patricia located in the Crow River area has been attended with satisfactory results, cross-cutting on several levels having encountered good ore. The question of the installation of a small mill will be decided by the result of this season's operations. The Metals Development is opening up a property in the Clearwater Lake area, where a shaft has been put down for 100 ft., at which depth a promising vein has been encountered. Surface exploration has been carried on and two test pits put down disclosed good gold values.

Manitoba.—The construction of the copper smelter at the Flin Flon mine is about one-half completed, and the electrolytic zinc plant has reached an advanced stage. A new discovery of copper-gold ore has been made at the bottom of a recently dewatered lake on the property. The Sherritt-Gordon is moving towards production and everything will be in readiness for the shipment of concentrates to Flin Flon as soon as the smelting plant is completed. The concentrator is being designed to handle about 1,800 tons daily. A feature of the Sherritt-Gordon is the fact that at 1,500 tons daily the mine may be made to yield ore carrying from 4 to 5% copper over a long period, reducing the cost to a level below the original estimates. Pitchblende is included in the list of minerals discovered on the property of the Winnipeg River Tin Company east of Lac Du Bonnett. It is found in association with tantalite and monazite, occurring in the form of crystals and irregularly shaped masses. An analysis of the pitchblende-ore has shown it to be strongly radio-active. On the 975 ft. level of the San Antonio Gold Mine in the Central Manitoba field, a vein has been cut showing high gold values over a width of 9 ft., proving the existence of pay ore at depth in this field.

CAMBORNE

August 5.

Unchanged Position.—As the months follow each other without apparent improvement in the position and prospects of the tin industry, the situation becomes increasingly difficult for Cornish tin mines. At £135 per ton for tin metal no Cornish mine can be profitably worked. Several months ago Wheal Reeth temporarily suspended operations, having been the first company in the county to take this step, in the hope that necessary financial assistance would soon be forthcoming to enable working to be resumed.

Further Suspensions Imminent.—Suspension is now contemplated at both Wheal Kitty and Polhigey, the two remaining Cornish mines of the Anglo-Oriental group. These two companies were founded about four years ago, and have unfortunately witnessed the price of tin continuously falling throughout their brief existence. It has been found necessary, in order to continue in active operation, to incur considerable financial obligations in the way of loans. Although operations are unlikely to be resumed under existing economic conditions, development has been such in both mines that, if the price of tin could be stabilized at £200 to £220 per ton, fair profits could be made. In any circumstances, the existence of a big loan is a heavy handicap, and must seriously interfere in case the present companies attempt to resume operations.

Polhigey.—At Polhigey a new mine was opened out from surface to a depth of about 500 feet. The ore-ground disclosed has proved to be comparatively extensive, though the average grade has been low, and extraction consequently poor.

Wheal Kitty.—This company reports 7,100 ft. of development in the past year, during which the sales were 524 tons of black tin, from the crushing of 39,980 tons of ore. The average recovery was 29·4 lb. of black tin to the ton. Considerable local surprise has been caused by the fact that the deepening of existing shafts has not been undertaken by the present company, nor has any new shaft been started. All returns of tin have been raised from within the depths accessible from previously-existing workings. Wheal Kitty is the only active mine in St. Agnes parish, and its permanent stoppage would be a great disappointment locally, for great faith exists in the future of the property if prosecuted northwards at increased depths. Bore-hole sinking two or three years ago is believed to have proved the non-existence of other productive lodes within 500 ft. vertically below the engine shaft, but the main lode, from which large returns of tin have been made by successive companies, underlies rapidly northwards and has proved productive to the deepest point yet reached, only about 500 ft. vertically below the adit level. The circumstances under which suspension is taking place leave grounds for hoping that it may be temporary only. Customary arrangements have to be made

for notifying the mineral owners of the intention to stop the pumps, so that all reasonable precautions can be adopted in view of the possibility of resumption, or of reconstruction.

Labour.—The older mines, including East Pool and Agar, South Crofty and Geevor, continue to take precautionary measures rendered necessary by the prolonged period of depression. Costs are reduced where possible, and development reasonably curtailed. The monthly losses incurred in continuing operations are met out of cash reserves. That, in some cases, such reserves are not inconsiderable is demonstrated by the recent announcement by the Geevor directors that £20,000 out of reserves have just been invested in 5% War Loan. Naturally, unemployment continues to increase in the mining districts of the county. The January numbers of unemployed on the registers for Redruth, Camborne, St. Just, Perranperth and St. Agnes were 1,748. In July these were 2,163 in the above-named areas, and there is no doubt that a considerable further increase will take place during the current month.

PERSONAL

R. Allan is returning from West Africa.
H. D. Allen has left for the Gold Coast.
A. E. Andrews has gone to New Guinea.
Percy Bonds is home from South Africa.
C. A. Bott is returning from Malaya.
R. S. Botsford is home from Colombia.
P. M. Bussey is home from Nigeria.
Charles Camsell has been elected president of the Royal Society of Canada.
Nigel C. Cooke is returning from Nigeria on leave.
T. J. Foster has left for West Africa.
T. Hirst is here from the West Coast.
D. J. Inskipp has returned from South Africa.
R. Underwood Jarvis is leaving for California.
H. J. Jeffers has left for the Gold Coast.
Heriot G. Jellard is home from Tanganyika.
A. Leaver is returning from Nigeria.
A. M. Mackilligin has left for Brazil.
A. J. Morris is returning from Colombia.
W. S. New is returning from Bolivia.
James P. Norrie is returning from Mexico.
A. F. B. Norwood has left for Spain.
J. Scott Park is home from Nigeria.
J. J. Peele is here from Nigeria.
R. C. F. Phillips is home from Algeria.
W. E. Sevier is returning from Malaya.
F. N. Spettigue is returning from British Columbia and is leaving for Spain.
Leslie F. Strong is returning from Malaya.
R. Symons is returning from Malaya.
A. H. E. Turner is returning from West Africa.
K. S. Twitchell has returned to the United States.
J. D. Williams is returning from Nigeria.
Louis A. Wright has returned from a visit to the United States.

H. H. Yuill has returned to Vancouver from visiting Bolivia.

John D. Hoffmann died in the United States on July 30 at the age of 51. He was educated at the University of California and after assisting his father Charles F. Hoffmann and his uncle Ross E. Browne on a number of their examinations he went to Mexico. Subsequently he visited Alaska and the Phillipine Islands and later was employed in South Africa by a British company for several years. He was associated in London with the office of H. C. Hoover and later carried out a number of examinations in Russia, Siberia, and Manchuria, Northern Persia, Sumatra and Abyssinia.

TRADE PARAGRAPHS

Lodge-Cottrell, Ltd., of George Street, Birmingham, notify us that this is now their address in place of 51, Great Charles Street, as hitherto.

Edgar Allen and Co., Ltd., of Sheffield, issue a catalogue of rotary kilns and coolers such as are used in the cement industry. Details are included in the catalogue of systems of pulverized fuel firing.

Ruston-Bucyrus, Ltd., of Lincoln, have issued further literature devoted to their new 1030 convertible excavator. This machine was described in some particulars last month. Interest nevertheless attaches to the photograph which we publish here of one of the forms of this excavator—known as a drag shovel—with which mining men are not so familiar.

Ruston-Bucyrus 1030 Drag Shovel.

Bureau of Information on Nickel of the Mond Nickel Co., Ltd., of Imperial Chemical House, London, S.W. 1, issue a booklet describing in some detail with several illustrations the progress of nickel deposition in recent years.

Demag, of Duisburg, Germany, send us the May issue of their *Demag News*, which contains an article on geared electric winding engines. The July number contains an article describing their steam piston pumps, as well as a number of other contributions of interest.

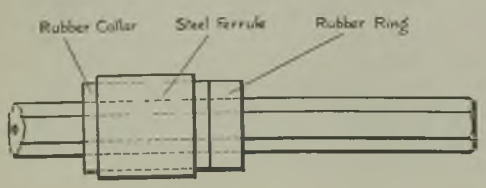
Genter Thickener Company, of Salt Lake City, New York, and London, issue a booklet describing this well-known piece of ore-dressing equipment. The present publication is fully illustrated with photographs and sectional drawings to show the details of its operation and types of plant for which it is adapted.

Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, in the May issue of their *Gazette* have an article on protective devices for mine hoists. The June issue of this publication contains an article describing lead mining under Helvellyn and also descriptions of two hydro-electric stations, one at Inverness and the other in Mexico.

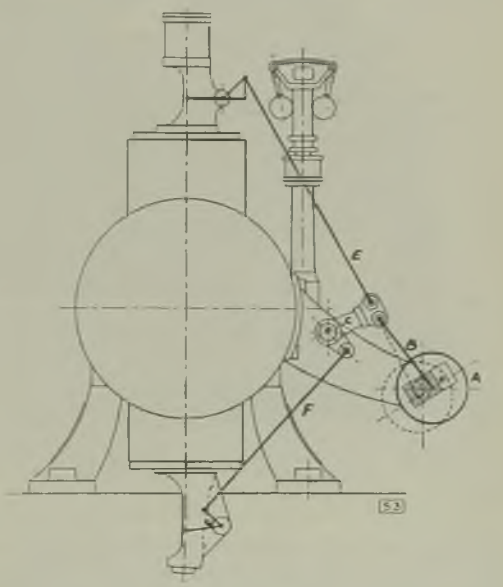
International Combustion, Ltd., of Africa House, Kingsway, London, W.C. 2, furnish us with particulars of a further contract secured by them for pulverized fuel installations. This has reference to the Brimsdown Power Station of the North Metropolitan Power Station Co., Ltd., and will comprise four combustion steam generators of 175,000 to 200,000 lb. per hour evaporation at 325 lb. pressure and 780° F., each boiler being unit fired by Raymond-Lopulco mills. This is the third such order for this station.

Mining and Industrial Equipment, Ltd., of 11, Southampton Row, London, W.C. 1, report that new orders have been received for the following equipment:—For England: One 8 ft. by 5 ft. 2 surface, type 31, Hum-mer screen for sugar crystals. For France: Six 8 ft. by 60 in. Hardinge ball mills for coal; one 3 ft. by 18 in. Hardinge ball mill for grit (5 cwts. per hour, 90% through 100 mesh); one 3 roller "Baby" Raymond mill for carb. of lime (10 cwts. per hour, 99·5% through 300 mesh); one No. 1 Raymond pulverizer for 16 cwts. per hour of litharge (98% through 300 mesh); one No. 00 Raymond pulverizer for unnamed duty; three 4 ft. by 7 in. S.B.T., type 37, screen for coal slack (60 tons per hour, separation at 0·8 mm.). For South Africa: Three No. 70 "Impax" pulverizers for coal (6,000 lb. per hour). For India: One No. 3 "Impax" pulverizer for unnamed duty. For Canada: One 8 ft., type 31, Hum-mer screen for cork.

Holman Bros., Ltd., of Camborne, and Broad Street House, London, E.C. 2, send us some particulars of a device which has originated on the Rand goldfield. It is simply a rubber collar for fitting on to a shank of hexagonal drill steel, which is intended to save breakages. As will be seen from the accompanying sketch, a rubber cylinder covered by a steel ferrule is forced over the shank end of the steel into the position which, allowing for the ring, will give the required length of shank to secure the collar. The ferrule is squeezed tight on to the rubber which can best be done in a drill sharpener. The rubber ring is then forced over the shank end and pushed down against the collar. This small ring, which takes the concussion, is removable and easily replaced by a new one. On a large mine which for some time has been using thousands of steels fitted with these rubber collars, the reduction in the number of breakages has resulted in the monthly steel bill being about 33⅓% lower than when shanks with forged collars were in use. They also send us a recently issued catalogue drawing attention to air compressors, air motors, haulage engines, and the principal types of drills, drill sharpeners and spare parts manufactured by them.



Robey and Co., Ltd., of Lincoln, publish a booklet which is fully illustrated with photographs and drawings describing their drop valve steam winding engines, the essential feature of which is the drop valve reversing gear. Both steam and exhaust valves are operated by the eccentric A, as may be seen from the accompanying sketch. This is effected by the rod B actuating the rocking lever C, which is supported on a fixed bearing D, giving an up and down motion to the steam actuating rod E, and the exhaust lever F; the latter by means of the bell crank lever G, opening

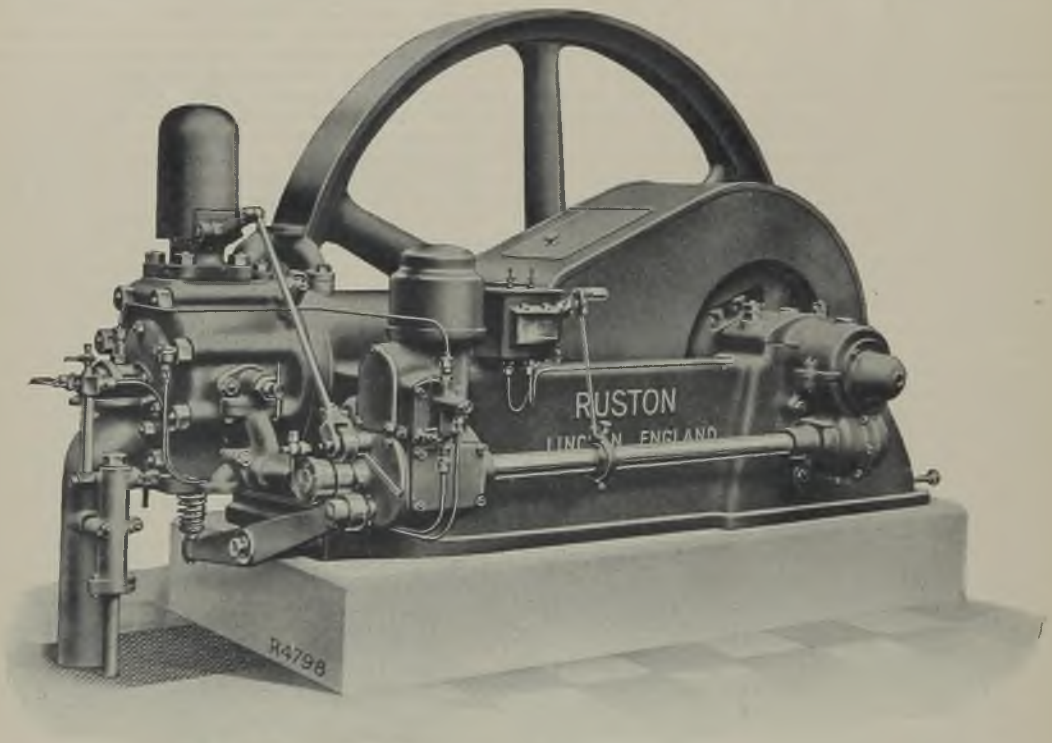


the exhaust valve at the proper moment. The steam admission rod E by means of the trip-motion opens the steam valve. It will be seen that the rods E and F have a constant movement, and the reversing is done by varying the position of the rod B. This is effected by moving the eccentric A'. (The strap and connexions are left off in this illustration.) This eccentric is mounted on a square block H, which is driven from a fixed plate on the layshaft. By means of the sliding sleeve on the layshaft, and two bell crank levers, the eccentric A can be moved to the position indicated by the dotted lines, and the engine will then run in the opposite direction. The sliding sleeve is connected

by a simple fork connexion to the reversing lever. The power necessary to move this eccentric A is very small indeed, and the lever can be worked by hand in engines up to large sizes. Some particulars concerning the drop valve engine itself were given in these columns in December 1928. The booklet gives complete details of all engine parts, winding drums, overwind and overspeed prevention gear and other salient features.

Fried-Krupp Grusonwerk, A.G., of Magdeburg, Germany, have issued a booklet commemorating the 75th anniversary of their organization which, in addition to a historical review, contains particulars, fully illustrated, of all their various productions, chief among which may be mentioned crushing machinery and complete crushing plants, cement machines, giant rock breakers, road-making machinery, plant for the manufacture of common salt and potassium chloride, all kinds of ore-dressing plant and equipment and smelting plant, rolling mills for iron and steel and non-ferrous metals and alloys, cable and wire-rope making machinery, machines for a variety of industries such as rubber, celluloid and explosives, cranes, loading equipment and other handling plant, hydraulic mechanism and steel work for sluices and such like, and a variety of foundry products. Particulars are also included of their experimental station for conducting crushing, grinding, and other tests on customers' ores.

Westinghouse Electric International Co., of 2, Norfolk Street, London, W.C. 2, inform us that they have entered into a comprehensive arrangement with the **English Electric Co., Ltd.,** of Queens House, Kingsway, London, W.C. 2, whereby there will be an exchange of technical information between the two organizations on steam turbines and electrical apparatus. It will be recalled that the latter has recently undergone reorganization. They also furnish us with particulars of a new turbine driven, propeller type, forced draft blower which is rated at 75,000 cu. in. at 10 in. water static pressure. They also send us leaflets devoted to the following :—Geared turbine generator units, induction frequency changers, starting and speed regulating rheostats, motors and control for pipeline pumping, motors and control for oilfields, electrical equipment for mines and hoists, speed reducers, linestarters, electric arc welding equipment and the August-September number of their *Westinghouse International* which has an article on heat treatment of drill steels in Westinghouse electric furnaces.



Ruston Cold-Starting Crude-Oil Engine.

NEW RUSTON OIL ENGINE

Ruston and Hornsby, Ltd., of Lincoln, have added further to their range of cold-starting crude-oil engines. This is a horizontal engine made as a single-cylinder in sizes of 10 to 66 b.h.p. and as a twin-cylinder for 76 to 132 b.h.p. All round improvements in construction have resulted in reduction in fuel consumption which is given, under average local conditions, as not exceeding 0·40 lb. per b.h.p. hour for the larger and 0·47 lb. per b.h.p. hour for the smaller engines. Without entering into detail as to the design of this engine attention may be directed to a number of salient features. The cylinder head is cast separately and is secured by long studs passing through bosses, which studs are not exposed to the corrosive

action of the cooling water. The piston is of special design with floating gudgeon pins. The fuel pump is of the spill-valve type and is packingless and the atomizer is the well-known type which has been used in Ruston engines for some years now. The governor is of the centrifugal type and is gear driven. It regulates evenly the quantity of fuel delivered to the engine in accordance with the load and such that there is an explosion at every power stroke, resulting in smooth running and close speed regulation. Ruston oil engines of the airless injection type have now been manufactured for more than 16 years and possess many advantages, among which special mention may be made of their easy starting from cold, their ability to run on low-grade fuel oil and their economy in fuel consumption.

METAL MARKETS

COPPER.—Both the standard copper market in London and the market for electrolytic metal in New York were rather easy, on balance, during July. The quotation for standard declined moderately whilst that for electro dropped from 12 to 11 cents. per lb. Until towards the close of the month, consumers on both sides of the Atlantic were inclined to take but little interest in the metal, but subsequently there was a wave of buying. Despite their large surplus stocks, copper producers doled out supplies to European consumers in a comparatively parsimonious fashion. There were rumours that the price was likely to be advanced, but this did not materialize and there is a considerable body of opinion which considers that the statistical position rather justifies a reduction. It was not expected that the buying movement would last far into August.

Average price of Standard Cash Copper: July, 1930, £48 6s. 10d.; June, 1930, £50 1s. 4½d.; July, 1929, £72 3s. 11d.; June, 1929, £74 7s. 9d.

TIN.—This market was very steady during July, sentiment being sustained by the increased support which the promoters of the scheme to curtail output have received. No less than 94 mining companies operating in British territory and in Siam have signified their desire to join in, as far as possible, the two or three months' shut-down. If this fully materializes, production during the second half of 1930 should be reduced by some 17,000 tons quite apart from output-cuts on the part of chinese-owned properties in the East and by mining concerns in other parts of the world. Obviously, such a drastic reduction in output ought materially to assist the statistical position and it now only remains to be seen whether it will actually become a fact. Demand from consumers has remained rather subdued and there are so far but few signs that any early industrial revival is at all likely which could result in an expansion in the use of tin.

Average price of Standard Cash Tin: July, 1930, £134 11s. 10d.; June, 1930, £136 7s. 8d.; July, 1929, £209 11s. 6d.; June, 1929, £200 5s. 9d.

LEAD.—Very steady conditions prevailed on the London lead market last month. Consumers were at times inclined to buy more heavily than was previously the case, but, generally speaking, their takings were not extensive. On the other hand fresh arrivals of metal into this country were slower and the surplus stocks—rather an unknown quantity—remained firmly held. Of course, but for the control exercised by the Lead Producers' Association, prices would probably be rather lower than they are, but nevertheless, although this fact is generally realized, there is a considerable amount of quiet confidence in the position expressed in certain quarters. Future arrivals are likely to remain somewhat restricted for some time to come. The metal has continued to rule well above the level of spelter, which in more normal times is the dearer metal of the two.

Average mean price of soft foreign lead: July, 1930, £18 2s. 2d.; June, 1930, £17 19s. 4d.; July, 1929, £22 16s. 10d.; June, 1929, £23 12s. 11d.

SPELTER.—Although consumption has remained quiet, this market showed signs of firmness during the major part of July, in anticipation that the discussions at Ostend between the world's zinc producers in connexion with the proposed International Cartel would lead to a definite and favourable result. Considerable progress seems, as a matter of fact, to have been secured and a fairly comprehensive scheme of output and price control has been worked out, but it seems unlikely, in the most favourable circumstances, that the Cartel can be finally completed until the autumn, even if the outstanding problems can be settled. In view of this, values underwent a relapse towards the close of July, as a result of which they closed practically unaltered on the month.

Average mean price of spelter: July, 1930, £16 9s. 5d.; June, 1930, £16 14s. 7d.; July, 1929, £25 7s. 6d.; June, 1929, £26 2s.

IRON AND STEEL.—The general position deteriorated rather than improved during July. Output was curtailed further in the Cleveland pig-iron-producing industry, and Cleveland material had to encounter keen foreign competition on export markets and also the rivalry of Indian pig-iron in Scotland. Prices of Midland pig-iron were reduced owing to the competition of imported material. Cleveland prices remained steady, with No. 3 foundry G.M.B. quoted at 67s. 6d. minimum. Hematite was a rather easy market, with East Coast Mixed Nos. priced at 71s. per ton by works, but with merchants under quoting this figure. The market for British finished iron and steel was unrelieved, but the position is likely to be improved somewhat later on by various big contracts which have been placed for ships and underground-railway tube segments. Export demand has been very dull and this has also applied to Continental steel, the market for which is erratic as a result of the refusal of a big Belgian works to join the new international sales offices. Prices of Continental steel have been reduced all round and it remains to be seen whether, as the Cartel claims, this is merely a preliminary to its forging a still stronger hold over the European steel plants. The drop in foreign steel prices is of course an adverse development from the British viewpoint.

IRON ORE.—The market has undergone very little change since our last report, new business still being negligible and works generally overstocked. Prices are wholly nominal, best Bilbao rubio being somewhere around 19s. 6d. to 20s. per ton c.i.f.

ANTIMONY.—At the close of the month of July, English regulus was quoted at between £38 and £46 10s., whilst Chinese was priced at about £26 10s. to £27 ex warehouse for spot and at £24 c.i.f. nominal for shipment material.

ARSENIC.—Only a limited demand is in evidence, but 99% Cornish white remains at £15 15s. per ton f.o.r. mines.

BISMUTH.—There is no change in the official price, which stands at 4s. per lb. for 5 cwt. lots and over.

LONDON DAILY METAL PRICES

Copper, Tin, Zinc, and Lead per Long Ton; Silver per Standard Ounce; Gold per Fine Ounce.

	COPPER.				TIN.		ZINC (Spelter).	LEAD.		SILVER.		GOLD.
	STANDARD.		ELECTRO-LYTIC.	BEST SELECTED.				SOFT FOREIGN.	ENGLISH.			
	Cash.	3 Months.			Cash.	3 Months.				Cash.	Forward.	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	s. d.
July												
11	47 10 0	47 6 10½	53 10 0	52 10 0	133 18 9	135 12 6	15 15 0	18 3 9	19 10 0	16½	16	85 0¾
14	47 9 4½	47 9 4½	53 10 0	—	132 13 9	134 3 9	15 15 0	18 6 3	19 10 0	16	15⅞	85 0¾
15	48 3 9	47 19 4½	53 10 0	52 10 0	131 8 9	133 1 3	15 18 9	18 5 0	19 10 0	15 15/16	15 15/16	85 1½
16	48 3 4½	47 19 4½	53 10 0	—	134 10 0	136 1 3	16 5 0	18 7 6	19 15 0	15 15/16	15 15/16	85 1½
17	47 16 3	47 13 9	53 0 0	—	135 11 3	137 3 9	16 10 0	18 5 0	19 15 0	16	15 15/16	85 1½
18	47 4 4½	47 3 1½	52 10 0	51 0 0	134 7 6	135 17 6	16 8 9	18 3 9	19 15 0	15⅞	15⅞	85 1½
21	47 6 10½	47 3 1½	52 0 0	—	135 12 6	137 7 6	16 5 0	18 3 9	19 15 0	15 15/16	15 15/16	85 1½
22	47 10 0	47 6 3	51 10 0	50 10 0	135 3 9	137 1 3	16 13 9	18 2 6	19 15 0	16	15⅞	85 1
23	47 9 4½	47 6 10½	51 5 0	—	134 12 6	136 7 6	16 16 3	18 3 9	19 15 0	16 1/16	15 15/16	85 1
24	48 17 6	48 11 3	51 10 0	—	134 12 6	136 3 9	16 16 3	18 5 0	19 15 0	16	15⅞	85 1
25	49 13 9	49 11 10½	52 15 0	51 10 0	134 18 9	136 13 9	16 16 3	18 5 0	19 15 0	16 1/16	16 1/16	85 1
28	48 14 4½	48 10 7½	52 0 0	—	135 18 9	137 13 9	16 13 9	18 5 0	19 15 0	16¼	16 1/16	85 0¾
29	48 11 3	48 8 9	52 0 0	51 5 0	134 17 6	136 8 9	16 10 0	18 6 3	19 15 0	16 1/16	16	85 0⅞
30	48 8 9	48 4 4½	51 15 0	—	134 8 9	135 18 9	16 2 6	18 5 0	19 15 0	16	15 15/16	85 0⅞
31	48 4 4½	48 4 4½	51 17 6	—	134 13 9	136 8 9	16 0 0	18 5 0	19 15 0	16	15 15/16	85 0⅞
Aug.												
1	48 11 3	48 11 3	51 10 0	50 5 0	135 13 9	137 6 3	16 1 3	18 3 9	19 15 0	16	15 15/16	84 11⅞
5	48 16 3	48 15 7½	51 10 0	50 5 0	136 18 9	138 13 9	16 0 0	18 5 0	19 15 0	15 15/16	15⅞	84 11⅞
6	48 11 10½	48 11 3	51 10 0	—	135 12 6	137 12 6	15 18 9	18 7 6	19 15 0	15 15/16	15⅞	84 11⅞
7	48 4 4½	48 4 4½	51 10 0	—	136 11 3	138 8 9	16 2 6	18 7 6	19 15 0	15 15/16	15⅞	84 11⅞
8	48 6 10½	48 6 10½	51 10 0	50 5 0	136 8 9	138 6 3	16 1 3	18 7 6	19 15 0	15 15/16	15⅞	84 11⅞

CADMIUM.—Business recently has not attained large proportions and prices have had a slightly easier tendency, current quotations being about 3s. 5d. to 3s. 7d. per lb.

COBALT METAL.—The turnover so far this year has been much smaller than in 1929, but the official price is upheld at 10s. per lb., although rebates are granted for good contracts.

COBALT OXIDES.—Quotations remain unaltered at 8s. per lb. for black and 8s. 10d. for grey.

CHROMIUM.—The price is steady at 2s. 6d. per lb.

TANTALUM.—Hardly any demand is received, but the price is still in the neighbourhood of £40 to £50 per lb.

PLATINUM.—Rather quiet conditions have prevailed in this market, but the official price is still pegged at £8 15s. per oz. for refined metal. In the outside market, however, about £8 10s. is accepted for merchant parcels.

PALLADIUM.—A few small lots continue to change hands at about £4 10s. to £4 15s. per oz.

IRIDIUM.—Business has not been large since sellers advanced prices to the current level of £51 10s. per oz. for sponge and powder.

OSMIUM.—Values of this metal have appreciated further in sympathy with Iridium, the present price being about £15 10s. to £16 10s. per oz.

TELLURIUM.—In the absence of demand quotations are nominally unchanged at 12s. 6d. to 15s. per lb.

SELENIUM.—There is a steady business passing in high grade black powder at 7s. 8d. to 7s. 9d. per lb. ex warehouse.

MANGANESE ORE.—Demand has remained at a standstill throughout the past month and the only feature of interest is the attempt of the American Manganese Producers' Association to get imports of Russian ore into the United States banned, on the grounds that the labour used is practically slave labour. Meanwhile prices are nominally unaltered at 1s. 1½d. per unit c.i.f. for best Indian and 1s. 0¼d. to 1s. 0½d. for washed Caucasian.

ALUMINIUM.—The German import duty finally became effective on August 1, the old licence scheme being abandoned from that date. The general quietness in metals has been seen also in aluminium, but makers adhere to their recent prices of £95 delivered, less 2% for ingots and bars.

SULPHATE OF COPPER.—Easier conditions in the copper market have reacted on sulphate, English material now being quoted at £23 10s. to £24 per ton, less 5%.

NICKEL.—Demand has not been very good recently, but leading interests are still proceeding with their expansion schemes, and the price is unchanged at £170 to £175 per ton.

CHROME ORE.—Quiet conditions rule here, with quotations steady at £4 2s. 6d. to £4 7s. 6d. per ton c.i.f. for good 48% Rhodesian.

QUICKSILVER.—Although sellers have maintained prices at £22 12s. 6d. to £22 15s., full terms, for spot material, the volume of business passing is remarkably small.

TUNGSTEN ORE.—This has been a most uncertain market for weeks past and clearly defined quotations have been impossible. However, the weakest moment is past and for forward shipment from China quotations now stand at around 16s. to 16s. 6d. per unit c.i.f., with some sellers asking up to 17s.

MOLYBDENUM ORE.—The absence of any appreciable demand for ferro-molybdenum has prevented any revival in enquiry for ore, but prices keep steady at about 32s. 6d. to 33s. per unit c.i.f. for 80 to 85% concentrates.

GRAPHITE.—Producers are having a rather lean time just now, although prices have not fallen very markedly. Madagascar 85 to 90% flake is worth somewhere about £25 per ton c.i.f. and Ceylon lumps around £24 c.i.f.

SILVER.—On July 1 spot bars closed at 15 1/16d., falling on the next day to 15 5/16d. At this figure, however, there was a slight improvement, following some bear covering by India and China. On July 15 the price was 15 15/16d., but the tone of the market was very uncertain. However, values maintained the lost ground fairly well, spot bars closing on July 31 at 16d.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
July, 1929	853,370	36,110	889,480
August	850,052	38,649	889,601
September	814,707	34,846	849,553
October	853,609	35,081	888,690
November	827,952	33,641	861,593
December	813,574	37,560	851,134
January, 1930	848,245	34,556	882,801
February	783,086	35,102	818,188
March	852,089	37,281	889,370
April	831,996	36,610	868,606
May	876,893	39,320	916,213
June	847,352	40,515	887,867
July	871,468	41,184	912,652

TRANSVAAL GOLD OUTPUTS.

	June.		July.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	85,000	£136,964	88,500	£140,470
City Deep	97,500	25,665	103,000	27,090
Cons. Main Reef	62,000	21,752	65,000	22,492
Crown Mines	245,000	78,117	247,000	80,058
D'rb'n Roodepoort Deep	42,500	13,854	45,800	15,070
East Rand P.M.	151,000	40,775	155,500	42,526
Geduld	83,000	26,442	86,000	27,632
Geldenhuis Deep	68,100	15,092	70,800	15,878
Glynn's Lydenburg	6,500	2,189	6,800	2,240
Government G.M. Areas	196,000	£380,534	212,000	£409,233
Kleinfontein	51,800	11,095	52,800	11,297
Langlaagte Estate	79,000	£114,706	84,000	£119,639
Luipaard's Vlei	27,500	7,046	30,000	7,579
Meyer and Charlton	17,800	£18,882	18,400	£18,831
Modderfontein New	154,000	72,807	161,000	73,069
Modderfontein B	69,000	23,994	71,500	25,147
Modderfontein Deep	43,000	22,511	45,900	23,833
Modderfontein East	68,000	19,699	72,500	20,738
New State Areas	76,000	£155,800	80,000	£164,802
Nourse	64,500	18,236	66,500	18,886
Randfontein	220,000	£229,053	221,000	£239,048
Robinson Deep	141,000	35,414	97,000	27,742
Rose Deep	60,300	13,217	62,600	13,675
Simmer and Jack	77,300	20,542	74,800	20,814
Springs	66,700	£140,071	74,700	£152,379
Sub Nigel	30,000	25,785	30,900	26,927
Transvaal G.M. Estates	14,870	4,363	15,400	4,524
Van Ryn	41,000	£41,285	64,000	£106,313
Van Ryn Deep	61,000	£104,331	42,000	£42,145
West Rand Consolidated	90,000	£103,573	92,500	£104,764
West Springs	67,600	£76,573	70,600	£79,184
Witw'tersr'nd (Knights)	54,000	£51,525	56,000	£51,007
Witwatersrand Deep	41,000	13,020	42,400	13,711

COST AND PROFIT ON THE RAND, Etc.

Compiled from official statistics published by the Transvaal Chamber of Mines.

	Tons milled.	Yield per ton.	Work'g cost per ton.	Work'g profit per ton.	Total working profit.
		s. d.	s. d.	s. d.	£
April, 1929	2,606,420	28 1	19 11	8 2	1,068,103
May	2,694,610	28 0	19 10	8 2	1,100,461
June	2,543,550	28 3	19 10	8 5	1,065,191
July	2,649,560	28 1	19 8	8 5	1,112,246
August	2,661,800	28 1	19 9	8 4	1,111,834
September	2,530,370	28 2	19 10	8 4	1,056,839
October	2,658,100	28 1	19 8	8 5	1,115,744
November	2,559,450	28 3	19 11	8 4	1,071,199
December	2,528,000	28 3	19 11	8 4	1,058,231
January, 1930	2,618,600	28 2	19 9	8 5	1,103,718
February	2,421,100	28 5	20 0	8 5	1,019,482
March	2,663,820	28 1	19 8	8 5	1,121,216
April	2,549,250	28 7	20 1	8 6	1,084,504
May	2,741,634	28 1	19 8	8 5	1,153,549
June	—	—	—	—	1,141,197

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
July 31, 1929	190,031	15,914	4,845	210,790
August 31	190,062	15,867	5,071	211,000
September 30	190,567	15,733	4,814	211,114
October 31	189,739	15,533	4,555	209,827
November 30	186,941	15,320	4,561	206,822
December 31	184,280	15,326	4,811	204,417
January 31, 1930	190,663	15,288	5,889	211,840
February 28	196,752	15,495	6,584	218,831
March 31	200,134	15,350	7,002	222,316
April 30	202,434	15,109	5,565	223,108
May, 31	202,182	15,028	5,340	222,550
June 30	201,324	14,943	5,126	221,393
July 31	201,111	14,670	5,490	221,271

PRODUCTION OF GOLD IN RHODESIA.

	1927	1928	1929	1930
	oz.	oz.	oz.	oz.
January	48,731	51,356	46,231	46,121
February	46,461	46,286	44,551	43,385
March	50,407	48,017	47,388	45,511
April	48,290	48,549	48,210	45,806
May	48,992	47,323	48,189	47,645
June	52,910	51,762	48,406	45,208
July	49,116	48,960	46,369	—
August	47,288	50,611	46,473	—
September	45,838	47,716	45,025	—
October	46,752	43,056	46,923	—
November	47,435	47,705	46,219	—
December	49,208	44,772	46,829	—

RHODESIAN GOLD OUTPUTS.

	June.		July.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	24,400	10,995	24,600	10,512
Globe and Phœnix	6,146	5,724	6,107	6,038
Lonely Reef	5,800	3,792	5,700	3,859
Luiri Gold	1,579	£3,386	—	—
Rezende	6,400	2,710	6,400	2,704
Sherwood Star	5,000	£14,000	5,000	£13,469
Wanderer Consolidated	15,300	3,976	14,600	3,655

WEST AFRICAN GOLD OUTPUTS.

	June.		July.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	6,090	£8,046	—	—
Ashanti Goldfields	10,768	12,487	10,620	12,957
Taquah and Abosso	9,053	£14,965	9,700	£15,546

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.
	Oz.	Oz.	Oz.
July, 1929	28,086	1,421	1,203
August	37,032	2,178	567
September	32,751	1,739	381
October	35,445	—	789
November	28,460	—	473
December	33,650	1,459	1,636
January, 1930	25,472	952	209
February	31,307	1,354	350
March	27,946	2,562	382
April	36,652	1,812	1,081
May	32,967	3,480	580
June	41,738	—	—
July	34,174	—	—

AUSTRALASIAN GOLD OUTPUTS.

	June.		July.	
	Tons	Value £	Tons.	Value £
Associated G.M. (W.A.)	4,948	8,761	5,482	8,334
Blackwater (N.Z.)	3,260	5,536	3,650	6,151
Boulder Persev'ce (W.A.)	7,007	15,381	7,390	16,588
Grt. Boulder Pro. (W.A.)	9,632	23,727	—	—
Lake View & Star (W.A.)	7,053	21,187	—	—
Sons of Gwalia (W.A.)	13,738	13,068	14,350	14,801
South Kalgurli (W.A.)	8,291	15,869	8,506	16,550
Waihi (N.Z.)	17,265	{ 6,373* / 31,939†	17,762	{ 6,006 / 28,992

* Oz. gold. † Oz. silver.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	June.		July.	
	Tons Ore	Total Oz.	Tons Ore	Total Oz.
Balaghat	3,200	1,953	3,300	1,563
Champion Reef	8,095	5,374	8,405	5,506
Mysore	16,693	8,252	17,249	8,402
Nundydroog	11,500	6,967	11,588	6,951
Ooregum	12,000	5,303	12,500	5,120

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	June.		July.	
	Tons	Value £	Tons	Value £
Chosen Corp. (Korea)	8,970	12,475	10,260	14,529
Frontino & Bolivia (C'lbia)	2,320	9,774	2,410	10,196
Lena (Siberia)	—	—	—	—
Lydenburg Plat. (Trans.)	3,470	694*p*	4,180	858*p*
Marmajito (Colombia)	870	5,128	960	4,869
Fresnillo	86,209	6,776*d*	—	—
Onverwacht Platinum	1,044	101*p*	—	—
Oriental Cons. (Korea)	—	74,500*d*	—	82,250*d*
St. John del Rey (Brazil)	—	43,500	—	44,000
Santa Gertrudis (Mexico)	44,092	87,312*d*	—	—

d Dollars. *p* Oz. platinoids.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

Estimated at 70% of Concentrate shipped to Smelters. Long Tons.

January, 1930	6,128	July	5,525
February	4,768	August	—
March	5,763	September	—
April	5,407	October	—
May	6,043	November	—
June	5,590	December	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	May.	June.	July.
Ayer Hitam	95½	78½	65½
Batu Caves	27	28	—
Changkat	63	75	—
Chenderiang	42	—	—
Gopeng	62½	65½	60
Hongkong Tin	51	71½	44½
Idris Hydraulic	29½	29½	31
Ipoh	38	52½	43½
Jelapang	31	26	—
Kampar Malaya	69	66	—
Kampong Lanjut	90	85	—
Kamunting	106	92	111
Kent (F.M.S.)	25	18	27
Kepong	36	37	33
Kinta	24	22½	20
Kinta Kellas	29½	26½	22½
Kuala Kampar	65	80	—
Kundang	22	30	—
Lahat	15½	15	17
Larut Tinfields	36	35	—
Malaya Consolidated	72½	82½	76½
Malayan Tin	119	119	131
Meru	13½	18	12
Pahang	225	224½	225
Penawat	85½	119½	48½
Pengkalen	45	53½	65½
Petaling	173	158	149
Rahman	71½	77½	59½
Rambutan	9	10½	9
Rantau	48	36	—
Rawang	90	80	—
Rawang Concessions	45	40	—
Renong	108	96	80
Selayang	23	—	13
Southern Malayan	154½	154½	154½
Southern Perak	98½	84	83½
Southern Tronoh	81	71	51
Sungei Besi	45	45	37
Sungei Kinta	12½	15	12
Sungei Way	83½	78½	65½
Taiping	48	41	—
Tanjong	27	35½	38½
Teja Malaya	45½	36½	26½
Tekka	36	38½	33
Tekka-Taiping	57	65½	57
Temoh	51	29½	29½
Tronoh	69	68	60

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	May.	June.	July.
Amari	6	—	—
Anglo-Nigerian	9½	83	—
Associated Tin Mines	200	170	—
Baba River	16½	10	—
Batura Monguna	1½	1½	—
Bisichi	65	65	65
Daffo	—	7½	10½
Ex-Lands	55	—	—
Filani	2½	2½	4½
Jantar	26	26	15
Jos	22	18	—
Juga Valley	20	17	—
Junction	6	6	—
Kaduna Syndicate	59	39	—
Kaduna Prospectors	22	16	—
Kassa	27	19½	—
London Tin	220	220	—
Lower Bisichi	7½	8½	8½
Naraguta	20½	24½	—
Naraguta Durumi	—	8½	—
Naraguta Extended	8	16	—
Naraguta Karama	19½	22	—
Naraguta Korot	12	11½	—
Nigerian Consolidated	18	18	14
Offin River	8	7	6½
Ribon Valley	20	16	—
South Bukeru Areas	10	9	—
Tin Fields	—	7½	—
Tin Properties	13	8	—
United Tin Areas	23	35	—
Yarde Kerri	—	8	10

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	May.	June.	July.
Anglo-Burma (Burma)	9½	23	40
Aramayo Mines (Bolivia)	205	207	—
Bangrin (Siam)	53½	60	70½
Berenguela (Bolivia)	—	—	—
Consolidated Tin Mines (Burma)	77	96	210
East Pool (Cornwall)	82½	82½	83
Fabulosa (Bolivia)	112¾	127	110
Geevor (Cornwall)	60	52	49
Jantar (Cornwall)	29	25½	—
Kagera (Uganda)	28	28	28
Northern Tavoy	45	40	—
Patino	1,527	1,289	—
Polhigey (Cornwall)	23½	31	—
San Finx (Spain)	35*	35*	—
Siamese Tin (Siam)	146½	131½	159½
South Crofty (Cornwall)	64½	65	66½
Tavoy Tin (Burma)	20	25	—
Theindaw (Burma)	10	8	—
Tongkah Harbour (Siam)	67	93	115
Toyo (Japan)	—	52½	—
Wheal Kitty (Cornwall)	40	38½	—
Zaaiplaats	34½	34½	—

* Tin and Wolfram.

COPPER, LEAD, AND ZINC OUTPUTS.

		June.	July.
Broken Hill South	Tons lead conc.	5,837	—
	Tons zinc conc.	5,721	—
Burma Corporation	Tons refined lead.	6,420	6,420
	Oz. refined silver	609,934	580,000
Bwana M'Kubwa	Tons copper oxide	560	616
Electrolytic Zinc	Tons zinc	4,259	4,230*
Indian Copper	Tons copper	247	—
Messina	Tons copper	651	630
Mount Lyell	Tons concentrates	4,406‡	—
Namaqua	Tons copper	142	—
North Broken Hill	Tons lead conc.	6,670	5,260
	Tons zinc conc.	6,260	2,540
Poderosa	Tons copper ore	784	784
Rhodesia Broken Hill	Tons lead	—	—
	Tons slab zinc	1,632	1,570
San Francisco Mexico	Tons lead conc.	4,124	4,445
	Tons zinc conc.	3,624	2,914
Sulphide Corporation	Tons lead conc.	3,699†	—
	Tons zinc conc.	4,630†	—
Tetiuhe	Tons lead conc.	983	—
	Tons zinc conc.	2,354	—
Union Minière	Tons copper	—	—
Zinc Corporation	Tons lead conc.	4,999	—
	Tons zinc conc.	4,967	—

* Four weeks to July 23. † Six weeks to June 28.
‡ Four weeks to July 16.

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		May.	June.
Iron Ore	Tons	459,329	405,848
Manganese Ore	Tons	13,813	12,895
Iron and Steel	Tons	233,725	214,504
Copper and Iron Pyrites	Tons	33,955	30,196
Copper Ore, Matte, and Prec.	Tons	3,951	4,753
Copper Metal	Tons	13,364	17,672
Tin Concentrate	Tons	8,471	7,274
Tin Metal	Tons	1,020	850
Lead Pig and Sheet	Tons	27,925	27,916
Zinc (Spelter)	Tons	13,493	14,093
Zinc Sheets, etc.	Tons	2,182	2,085
Aluminium	Tons	1,489	1,285
Mercury	Lb.	26,111	68,703
Zinc Oxide	Tons	1,370	1,045
White Lead	Cwt.	16,753	13,498
Red and Orange Lead	Cwt.	4,023	7,727
Barytes, ground	Cwt.	47,194	54,501
Asbestos	Tons	2,844	1,642
Boron Minerals	Tons	772	620
Borax	Cwt.	14,609	12,950
Basic Slag	Tons	1,206	1,739
Superphosphates	Tons	7,509	3,342
Phosphate of Lime	Tons	42,842	47,973
Mica	Tons	324	207
Sulphur	Tons	10,278	6,758
Nitrate of Soda	Cwt.	64,497	18,531
Potash Salts	Cwt.	172,192	56,485
Petroleum: Crude	Gallons	53,210,133	42,974,679
Lamp Oil	Gallons	17,245,295	17,330,578
Motor Spirit	Gallons	106,857,354	95,304,527
Lubricating Oil	Gallons	9,685,996	8,375,641
Gas Oil	Gallons	19,945,772	9,539,927
Fuel Oil	Gallons	36,186,621	46,186,468
Asphalt and Bitumen	Tons	23,021	20,135
Paraffin Wax	Cwt.	82,076	118,428
Turpentine	Cwt.	19,422	43,827

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES

In Tons.

	May.	June.	July.
Anglo-Ecuadorian	17,168	16,127	16,818
Apex Trinidad	33,400	36,690	40,240
Attock	2,115	2,287	—
British Burmah	5,268	4,969	5,054
British Controlled	30,034	33,431	34,111
Kern Mex	712	667	724
Kern River (Cal.)	3,401	2,545	1,990
Kern Romana	2,813	2,663	2,421
Kern Trinidad	5,990	5,011	5,020
Lobitos	28,023	29,431	30,771
Phœnix	53,156	57,727	65,597
St. Helen's Petroleum	5,780	5,700	6,346
Steaua Romana	82,410	80,420	79,380
Tampico	3,131	2,942	3,011
Trinidad Leaseholds	31,550	28,200	25,600
Venezuelan Consolidated	1,626	1,583	—

QUOTATIONS OF OIL COMPANIES SHARES

Denomination of Shares £1 unless otherwise noted.

	July 10, 1930.			Aug. 9, 1930.		
	£	s.	d.	£	s.	d.
Anglo-Ecuadorian		15	6		15	0
Anglo-Egyptian B.	2	5	0	2	3	0
Anglo-Persian 1st Pref.	1	7	6	1	8	3
,, ,, Ord.	4	2	6	4	1	6
Apex Trinidad (5s.)	1	0	0		18	9
Attock	1	0	0	1	5	6
British Burmah (8s.)		5	3		4	9
British Controlled ($5)		3	0		2	0
Burmah Oil	4	5	0	4	5	0
Kern River, Cal. (10s.)		4	3		4	0
Lobitos, Peru	1	15	0	1	15	0
Mexican Eagle, Ord. (4 pesos)		13	3		12	6
,, ,, 8% Pref. (4 pesos)		13	3		12	0
Phœnix, Roumania		11	6		9	6
Royal Dutch (100 fl.)	32	12	0	32	10	0
Shell Transport, Ord.	4	13	9	4	14	6
,, ,, 5% Pref. (£10)	10	0	0	10	0	0
Steaua Romana		8	0		7	0
Trinidad Leaseholds	2	7	6	2	8	0
United British of Trinidad (6s. 8d.)		5	9		5	6
V.O.C. Holding	2	6	0	2	4	6

PRICES OF CHEMICALS. August 9.

These quotations are not absolute; they vary according to quantities required and contracts running.

		£	s.	d.
Acetic Acid, 40%	per cwt.		16	6
,, 80%	,,	1	16	3
,, Glacial	per ton	58	0	0
Alum	,,	8	10	0
Alumina, Sulphate, 17 to 18%	,,	6	15	0
Ammonia, Anhydrous	per lb.			10
,, 0·880 solution	per ton	15	10	0
,, Carbonate	,,	27	10	0
,, Nitrate	,,	24	0	0
,, Phosphate	,,	40	0	0
,, Sulphate, 20·6% N.	,,	10	2	0
Antimony, Tartar Emetic	per lb.			10½
,, Sulphide, Golden	,,			7
Arsenic, White	per ton	15	15	0
Barium, Carbonate, 94%	,,	4	10	0
,, Chloride	,,	10	0	0
,, Sulphate, 94%	,,	5	0	0
Benzol, standard motor	per gal.		1	7
Bleaching Powder, 35% Cl.	per ton	6	15	0
Borax	,,	13	10	0
Boric Acid	,,	22	0	0
Calcium Chloride	,,	5	5	0
Carbolic Acid, crude 60%	per gal.		2	2
,, ,, crystallized, 40°	per lb.			7
Carbon Disulphide	per ton	24	0	0
Citric Acid	per lb.		1	6½
Copper Sulphate	per ton	22	10	0
Cresylic Acid, 97–99%	per gal.			11
Creosote Oil (f.o.b. in Bulk)	,,			4½
Hydrofluoric Acid	per lb.			6
Iodine	per oz.		1	0
Iron, Nitrate 80° Tw.	per ton	6	0	0
,, Sulphate	,,	1	15	0
Lead, Acetate, white	,,	35	15	0
,, Nitrate	,,	29	10	0
,, Oxide, Litharge	,,	33	10	0
,, White	,,	42	0	0
Lime, Acetate, brown	,,	7	5	0
,, ,, grey, 80%	,,	14	10	0
Magnesite, Calcined	,,	9	10	0
Magnesium, Chloride	,,	6	15	0
,, Sulphate, comml.	,,	3	15	0
Methylated Spirit 64° Industrial	per gal.		1	9
Nitric Acid, 80° Tw.	per ton	21	0	0
Oxalic Acid	per cwt.	1	12	0
Phosphoric Acid	per ton	29	15	0
Pine Oil	,,	42	10	0
Potassium Bichromate	per lb.			4½
,, Carbonate	per ton	24	10	0
,, Chlorate	,,	26	5	0
,, Chloride 80%	,,	9	15	0
,, Ethyl Xanthate	per 1,016 kilos	55	15	0
,, Hydrate (Caustic) 90%	per ton	29	10	0
,, Nitrate, refined	,,	21	0	0
,, Permanganate	per lb.			5½
,, Prussiate, Yellow	,,			6½
,, ,, Red	,,		1	8
,, Sulphate, 90%	per ton	11	0	0
Sodium Acetate	,,	18	15	0
,, Arsenate, 45%	,,	26	0	0
,, Bicarbonate	,,	10	10	0
,, Bichromate	per lb.			3¾
,, Carbonate (Soda Ash)	per ton	6	0	0
,, ,, (Crystals)	,,	5	5	0
,, Chlorate	,,	24	10	0
,, Cyanide, 100% NaCN basis	per lb.			7
,, Ethyl Xanthate	per 1,016 kilos	53	5	0
,, Hydrate, 76%	per ton	14	10	0
,, Hyposulphite	,,	9	0	0
,, Nitrate, 96%	,,	10	2	0
,, Phosphate, comml.	per cwt.		11	0
,, Prussiate	per lb.			4¾
,, Silicate	per ton	9	10	0
,, ,, (liquid, 140° Tw.)	,,	8	10	0
,, Sulphate (Glauber's Salt)	,,	2	12	6
,, ,, (Salt-cake)	,,	2	15	0
,, Sulphide Conc., 60/65%	,,	10	0	0
,, Sulphite, pure	per cwt.		14	0
Sulphur, Flowers	per ton	11	10	0
,, Roll	,,	10	0	0
Sulphuric Acid, 168° Tw.	,,	4	16	6
,, ,, free from Arsenic, 144° Tw.	,,	4	0	0
Superphosphate of Lime, 33%	,,	3	9	0
Tartaric Acid	per lb.		1	0
Turpentine	per ton	35	0	0
Tin Crystals	per lb.		1	0
Titanous Chloride	,,			10
Zinc Chloride	per ton	12	0	0
Zinc Dust	,,	27	10	0
Zinc Oxide	,,	39	0	0
Zinc Sulphate	,,	10	10	0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

GOLD AND SILVER:	July 10, 1930. £ s. d.	Aug. 9, 1930. £ s. d.
SOUTH AFRICA:		
Brakpan	2 15 0	2 14 6
City Deep	6 0	7 3
Consolidated Main Reef	17 6	17 6
Crown Mines (10s.)	3 11 3	3 15 0
Daggafontein	1 4 0	1 5 0
Durban Roodepoort Deep (10s.)	11 3	13 3
East Geduld	1 19 6	2 4 6
East Rand Proprietary (10s.)	9 9	10 9
Geduld	3 14 6	3 15 6
Geldhenhuis Deep	7 0	7 9
Glynn's Lydenburg	2 6	2 6
Government Gold Mining Areas (5s.)	1 12 6	1 15 0
Langlaagte Estate	1 4 6	1 4 6
Meyer & Charlton	13 0	13 9
Modderfontein New (10s.)	3 17 6	3 18 9
Modderfontein B (5s.)	14 0	14 0
Modderfontein Deep (5s.)	1 5 0	1 5 0
Modderfontein East	1 6 0	1 4 6
New State Areas	1 16 3	1 18 9
Nourse	10 0	10 0
Randfontein	8 0	10 3
Robinson Deep A (1s.)	16 3	16 3
" " B (7s. 6d.)	9 0	9 9
Rose Deep	4 6	4 9
Simmer & Jack (2s. 6d.)	2 6	2 6
Springs	3 7 6	3 6 3
Sub Nigel (10s.)	2 15 0	2 17 6
Van Ryn	7 6	7 9
Van Ryn Deep	1 11 3	1 11 3
Village Deep (14s.)	3 0	3 6
West Rand Consolidated (10s.)	6 0	7 0
West Springs	14 0	14 6
Witwatersrand (Knight's)	10 0	9 9
Witwatersrand Deep	4 6	4 6
RHODESIA:		
Cam and Motor	18 0	17 0
Gaika	3 9	3 9
Globe and Phœnix (5s.)	13 6	14 0
Lonely Reef	1 0 0	1 0 0
Mayfair	10 0	10 3
Rezende	1 1 3	1 1 9
Shamva	1 0	1 0
Sherwood Starr (5s.)	1 0 0	17 6
GOLD COAST.		
Ashanti (4s.)	1 8 6	1 9 6
Taquah and Abosso (5s.)	2 6	2 6
AUSTRALASIA:		
Golden Horseshoe (4s.) W.A.	2 3	2 3
Great Boulder Propriet'y (2s.), W.A.	1 3	1 3
Lake View and Star (4s.), W.A.	12 3	11 0
Sons of Gwalia, W.A.	1 3	1 3
South Kalgurli (10s.), W.A.	12 9	12 6
Waihi (5s.), N.Z.	13 0	12 9
Wiluna Gold, W.A.	17 9	17 6
INDIA:		
Balaghat (10s.)	2 0	2 6
Champion Reef (10s.)	6 9	2 3
Mysore (10s.)	10 3	10 3
Nundydroog (10s.)	15 3	15 6
Ooregum (10s.)	5 0	5 0
AMERICA:		
Camp Bird (2s.), Colorado	9	6
Exploration (10s.)	5 0	4 0
Frontino and Bolivia, Colombia	11 6	11 6
Mexican Corporation, Mexico (10s.)	5 0	5 0
Mexico Mines of El Oro, Mexico	2 3	3 0
Panama Corporation	15 0	15 0
St. John del Rey, Brazil	16 9	16 6
Santa Gertrudis, Mexico	8 9	7 9
Selukwe (2s. 6d.), British Columbia	3 0	2 6
MISCELLANEOUS:		
Chosen, Korea	5 0	6 6
Lena Goldfields, Russia	3	3

COPPER:		
Bwana M'Kubwa (5s.) Rhodesia	13 3	12 3
Esperanza Copper, Spain	1 1 6	1 1 6
Indian (2s.)	1 3	1 6
Loangwa (5s.), Rhodesia	3 9	3 3
Luiri (5s.), Rhodesia	3 3	2 9
Messina (5s.), Transvaal	10 6	9 6
Mount Lyell, Tasmania	1 2 6	1 1 3
Namaqua (£2), Cape Province	7 6	7 6
N'Changa, Rhodesia	2 12 6	2 10 0
Rhodesia-Katanga	1 3 9	1 7 0
Rio Tinto (£5), Spain	34 12 6	35 0 0
Roan Antelope (5s.), Rhodesia	1 1 3	1 2 0
Tanganyika, Congo and Rhodesia	1 12 0	1 11 0
Tharsis (£2), Spain	4 0 0	3 19 0

LEAD-ZINC:	June 10, 1930. £ s. d.	Aug. 9, 1930. £ s. d.
Amalgamated Zinc (8s.), N.S.W.	9 6	8 0
Broken Hill Proprietary, N.S.W.	15 6	13 3
Broken Hill, North, N.S.W.	2 7 6	2 5 0
Broken Hill South, N.S.W.	1 13 9	1 13 9
Burma Corporation (10 rupees)	10 9	10 3
Electrolytic Zinc Pref., Tasmania	1 2 6	1 1 3
Mount Isa, Queensland	16 3	1 1 3
Rhodesia Broken Hill (5s.)	2 6	2 3
San Francisco (10s.), Mexico	14 6	15 0
Sulphide Corporation (15s.), N.S.W.	10 6	10 0
ditto, Pref.	17 0	16 3
Zinc Corporation (10s.), N.S.W.	1 1 3	1 1 3
ditto, Pref.	2 18 9	2 18 9
TIN:		
Aramayo Mines (25 fr.), Bolivia	1 2 6	1 3 0
Associated Tin (5s.), Nigeria	5 6	4 9
Ayer Hitam (5s.)	11 0	9 0
Bangrin, Siam	12 6	13 9
Bisichi (10s.), Nigeria	6 3	6 0
Chenderiang, Malay	1 6	1 6
Consolidated Tin Mines of Burma	3 9	3 9
East Pool (5s.), Cornwall	9	9
Ex-Lands Nigeria (2s.), Nigeria	1 6	1 6
Geevor (10s.), Cornwall	3 6	3 3
Gopeng, Malaya	1 18 9	1 17 6
Hongkong (5s.)	15 3	14 6
Idris (5s.), Malaya	6 6	6 3
Ipoh Dredging (10s.), Malay	17 0	16 6
Kaduna Prospectors (5s.), Nigeria	5 6	5 6
Kaduna Syndicate (5s.), Nigeria	12 6	12 6
Kamunting (5s.), Malay	6 0	5 9
Kepong, Malay	17 6	15 0
Kinta, Malay (5s.)	9 9	8 0
Kinta Kellas, Malay (5s.)	6 6	6 0
Kramat Pulai, Malay	1 3 9	1 1 3
Lahat, Malay	6 9	6 9
Malayan Tin Dredging (5s.)	18 3	18 3
Naraguta, Nigeria	8 9	8 0
Nigerian Base Metals (5s.)	1 0	1 0
Pahang Consolidated (5s.), Malay	7 6	7 0
Penawat ($1), Malay	1 3	1 3
Pengkalen (5s.), Malay	12 6	12 0
Petaling (2s. 4d.), Malay	10 0	10 3
Rambutan, Malay	8 9	9 6
Renong Dredging, Malay	1 0 0	18 0
Siamese Tin (5s.), Siam	9 9	9 9
South Crofty (5s.), Cornwall	2 6	2 3
Southern Malayan (5s.)	11 6	10 9
Southern Perak, Malay	1 13 9	1 8 9
Southern Tronoh (5s.), Malay	6 6	5 6
Sungei Besi (5s.), Malay	8 3	7 0
Sungei Kinta, Malay	14 0	11 6
Tanjong (5s.), Malay	9 9	8 6
Tavoy (4s.), Burma	5 3	4 6
Tekka, Malay	17 6	15 6
Tekka Taiping, Malay	16 3	13 9
Temengor, Malay	6 3	2 6
Toyo (10s.), Japan	3 6	2 6
Tronoh (5s.), Malay	15 6	14 6
DIAMONDS:		
Consol. African Selection Trust (5s.)	1 3 9	1 3 9
Consolidated of S.W.A. (10s.)	8 0	7 3
De Beers Deferred (£2 10s.)	7 5 0	6 15 0
Jaggersfontein	1 12 6	1 7 0
Premier Preferred (5s.)	4 5 0	3 19 6
FINANCE, ETC.:		
Anglo-American Corporation (10s.)	1 1 3	1 1 3
Anglo-French Exploration	15 0	13 9
Anglo-Continental (10s.)	7 0	6 3
Anglo-Oriental (Ord., 5s.)	8 0	7 9
ditto, Pref.	12 0	11 6
British South Africa (15s.)	1 18 0	1 12 6
Central Mining (£8)	16 5 0	16 10 0
Consolidated Gold Fields	1 12 0	1 12 6
Consolidated Mines Selection (10s.)	12 6	12 0
Fanti Consols (8s.)	12 0	10 3
General Mining and Finance	13 9	15 6
Gold Fields Rhodesian (10s.)	7 9	8 0
Johannesburg Consolidated	1 18 6	1 15 3
London Tin Corporation (10s.)	15 3	12 6
Minerals Separation	6 10 0	6 15 6
National Mining (8s.)	6	6
Rand Mines (5s.)	3 0 0	3 1 0
Rand Selection (5s.)	8 9	8 3
Rhodesian Anglo-American (10s.)	1 2 6	1 1 3
Rhodesian Congo Border	13 5 0	14 10 6
Rhodesian Selection Trust (5s.)	1 10 0	1 9 0
South African Gold Trust	1 5 6	1 5 6
South Rhodesia Base Metals	10 0	7 6
Tigon (5s.)	15 0	14 6
Union Corporation (12s. 6d.)	3 3 9	3 0 0
Venture Trust (10s.)	5 0	5 0

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section we give abstracts of important articles and papers appearing in technical journals and proceedings of societies, together with brief records of other articles and papers: also notices of new books and pamphlets, lists of patents on mining and metallurgical subjects, and abstracts of the yearly reports of mining companies.

COPPER EXTRACTION FROM LEACHED ORES

Factors involved in the leaching of ores have been discussed in a series of reports issued by the United States Bureau of Mines. Previous papers have discussed the necessity for such a study and the experimental results of certain phases of the problem have been presented. Technical Paper 472 of the same Bureau, written by M. Guggenheim and J. D. Sullivan, is a continuation of Technical Paper 453 and deals with the acceleration of extraction of soluble copper from leached ores.

The authors of this paper point out that there is a fundamental difference between vat or tank leaching and heap leaching. In the former the ore is covered with a leaching solution, and complete contact of ore and leaching solution is maintained over a period of time; whether countercurrent or batch leaching is employed, the same condition holds. After leaching has been continued for a given period the ore is washed with water or solutions weak in copper and leaching reagents, or both. The washing is also a flooding operation. During the washing and during the leaching itself dissolved copper from the interior of the particles of ore is diffused into the main solution that surrounds the ore. In heap leaching ore is piled in a heap, which should have a prepared bottom to prevent the loss of solution by seepage, and a certain quantity of solution is added to a given section, then another section is treated with fresh leach liquor, and so on. Several months may elapse before the first section is again treated with solution. It is added at the top, so downward-percolation leaching is employed. Thus the ore does not become flooded but is wet by the film of solution that covers the surface of the pieces of ore and gravitates downwards from one particle to another. Heap leaching results in a process of alternate wetting and drying. When a particle of ore is dried evaporation pulls the solution to the surface, where the dissolved salts crystallize as the solution evaporates; the next wetting removes these salts.

A few preliminary experiments on alternate wetting and drying were reported in Technical Paper 453 and showed that the process brought the copper to the surface in approximately one-fourth or one-fifth of the time for chemical diffusion. The removal of copper by alternate wetting and drying methods was studied further to determine the most desirable conditions for bringing the soluble copper to the surface in a minimum time; the results are reported in the present paper. There is a possibility that certain uses can be made of this study in vat washing, particularly where the volume of wash solutions and water is limited. The leaching or wash solution could be drained from the vat and the remaining mass dried for a time by a natural or a forced draft of air. Partial drying might very well bring a large amount of copper to the surface, which would be removed by the next wash solution.

The ore used in the authors' experiments was typical unweathered leaching ore obtained from the Copper Queen heap-leaching plant, Warren, Ariz.

Discussing their results, the authors state that when soluble copper is extracted from the interior of a rock by alternate wetting and drying, evaporation draws copper-salts to the surface during the drying period, and these salts are removed by washing. At the same time the salts are removed by washing some solution penetrates into the cavities, cleavage planes, and pores within the rock. If all the moisture within the rock is removed during the drying cycle, all of the soluble copper salts would be crystallized, partly at the surface and partly within the rock. The amount brought to the surface would depend to a large extent upon the size, shape, and general character of the voids within the ore. Under most conditions the copper salts would precipitate partly on the surface and partly along the entire length of the pores, cavities, and cleavage planes. When the ore is washed the distance the solution penetrates into the rocks is a function of the time of washing. Regardless of whether or not the moisture was completely removed in the drying process the rock will again become saturated if the washing period is long enough. If the rock was completely dried and the washing period is not long enough to return as much water as was removed in the drying period some of the copper crystallized along the inner pores would never be removed. An ideal cycle would be one in which the rock was completely dried and then completely saturated in one cycle. Such a cycle might be efficient as to the number of cycles required to extract a given percentage of copper but probably would be very inefficient as to the total number of hours required. Unless as much water is returned in washing as was removed in drying, the process of robbing the rock of solution will progress until eventually the inner part of the rock may be dry enough for salts to crystallize out within. A condition might thus arise wherein an apparent equilibrium would be reached yet no further copper would be removed, although there was still some within the rock. Such a condition is not likely to obtain because some solution would remain in the rock unless the rock was completely dried, and this solution would probably be higher in copper than the new solution that entered the rock during the washing. A concentration gradient would thus be built up, so that chemical diffusion would take place within the rock. For the best results as much water should be returned to the interior of the particles of ore during the washing as was removed during the drying.

In the tests reported not so much copper was extracted as would have been present within the ore had it become impregnated with the solution of the same strength that was soaked in. Other studies have shown that a penetration of approximately 30 c.c. of solution takes place in 2,000 grams

of −1+¾ inch Warren unweathered ore whose "apparent saturation" has been reached. A 5% solution of copper contains 0·05 gram. per cubic centimetre (neglecting the specific gravity, which is slightly greater than 1·0); 30 c.c. would therefore contain 1·5 grams. Actually this much copper was not extracted. The rock probably acts as a precipitant, and the solution entering the smaller pores and cavities may be very low in copper content. If a concentration gradient exists it might be measured electrically. The acid-soluble copper remaining in the ore residue after the test was completed and the water-soluble copper extracted was measured on several samples and found to be consistent with the acid-soluble content of the ore as it came from the mine. There was a possibility that some copper would be precipitated as basic sulphate during the experiment. If this happened, the acid-soluble copper in the residue would have been high.

The alternate wetting and drying tests in the laboratory could not be duplicated very easily in heap-leaching practice. In the laboratory the surface of the rocks may be dried completely, and it is possible to dry the entire sample. In heap leaching complete drying would be virtually impossible. Six inches was the maximum size of ore particles used in the laboratory tests, whereas pieces of rock as large as 6 ft. across the face are frequently found in leaching heaps. A heap may contain several millions of tons of ore and may occupy a large area and depth; so a complete drying, even of the surface, could hardly be anticipated. The tests reported show that the copper can be brought to the surface even though the particles of ore are only partly dried. Although one can not extrapolate from laboratory tests to those of commercial size, the experiments reported herein indicate the greater rapidity of removal of the water-soluble copper by alternate wetting and drying methods than by diffusion, as in flood leaching.

In heap leaching or any other leaching process it is desirable to extract the copper as rapidly as possible. When the ore is mined and placed on the heaps where the metal values are to be extracted the money involved in preparing the ore for leaching is already spent, except that necessary to keep the heap itself in condition to allow percolation of solution. The surface trellises that must be prepared for the addition of solution are examples of an additional source of expense. The economics of the process therefore demands that the metal values be extracted as rapidly as possible. The experimental data obtained suggest certain possibilities of accelerating extraction of the metal values.

Comparison of the rates of extraction of the water-soluble copper from 2 or 3 in. pieces and 5 to 6 in. pieces of ore shows the enormously longer time required for the large pieces. When a 0·5-hour period of washing and a 0·5-hour period of drying were used 80% of the water-soluble copper was extracted from 3-in. pieces in 6 hours, whereas 44 hours was required for the 5 to 6 in. pieces. In heap-leaching practice numerous pieces of ore as large as 5 or 6 ft. across the face are found, and those 2 to 3 ft. across are quite common. The relatively low cost of crushing with modern equipment would be offset very easily by the increased rate of extraction. Crushing of the ore particles would not only increase the rate of extraction of the water-soluble copper, but would also make the ore more amenable to leaching by exposing more surface, by opening cleavage planes and crevices in the ore particles, and by shortening the path required for the leaching solutions to come into contact with the mineral particle. Crushing to a smaller size than 2 or 3 in. might produce too many fines, and thus tend to counteract the advantages of crushing.

The alternate wetting and drying cycles should be as close to each other as is consistent with fairly thorough drying of the charge and soaking in of the leaching liquors. With 3 in. pieces of ore an extraction of 80% of the water-soluble copper was obtained in 6 hours with a 0·5-hour period of washing and a 0·5-hour period of drying, whereas 25 hours was required for a 2·0-hour period of washing and a 6·0-hour period of drying. In heap leaching very short periods of alternate wetting and drying can not be maintained, but the laboratory work has shown the advantage to be gained by keeping the cycles as close to each other as possible. Any advocacy of shorter cycles of wetting and drying presupposes that the heaps are porous and well aerated.

A rapid movement of air past the surface promotes rapid drying. Anything that interferes with the circulation of the air slows the rate of extraction, demonstrating the necessity of having an open heap where free circulation of air is possible. Slime or other material that will coat the surface would also hinder the drying operation.

The experiments have shown the time saved, with consequent lessening of interest charges, by crushing the ore finely and having periods of alternate wetting and drying closer together and of shorter duration than are now common. Where rocks are not crushed too finely trouble from slime should more than be compensated for by speed in dissolving and recovering the metal values.

Although the experimental data presented are particularly adaptable to heap leaching there is a possibility that under certain conditions the alternate wetting and drying principle might be utilized in vat leaching. The authors know that operating plants are now designed to handle certain tonnages and that a rather rigid fixed schedule of operation must be followed, so that any plans proposed are advocated for plants yet to be designed or for present operating plants that could easily be changed. From a commercial viewpoint, as applied to vat leaching, these experiments indicate the possibility of utilizing the alternate wetting and drying principle during the washing period in vat leaching. The ordinary practice in vat leaching is to crush all ore to pass a screen with approximately ⅜ in. openings, and all or part of the fines produced in crushing are charged into the vat. Fine materials and slimes complicate the washing operation, but the tests made with the smallest size used in this work are somewhat comparable. For the −1 +¾ inch size, regardless of the cycle used, at least 30% of the water-soluble copper is removed in one cycle, and with most cycles a 50% extraction is realized in one cycle. Although equal extractions might not be obtained in vat leaching the possible use of alternate wetting and drying to remove at least part of the soluble copper in the washing operation looks encouraging. After the last leaching liquors are drawn off, the charge in the vats could be allowed to dry for several hours, air being passed simultaneously through the charge from the bottom and wash solution then added from the top, as in

open-drainage leaching, or by upward percolation, as is now standard practice. The cycle could be repeated more than once if desirable. This scheme might be desirable for plants that have a scarcity of wash water. Drying the ore would pull out the richest of the copper solution and so increase the copper content in the first wash solutions. The scheme also seems attractive for plants that have trouble with segregation of slime, so that part of the ore in the tank is scarcely washed under present operating conditions. It is entirely possible that in drying, inasmuch as the more open areas dry more rapidly, some of the copper from the segregated areas of slime would be pulled to the drier open areas and copper recovered thereby that might be lost by present practices.

Conclusions.—1. The alternate wetting and drying tests described in the paper show that the maximum rate of extraction of water-soluble copper was usually obtained by employing a 0·5 or 1·0 hour drying period; likewise a 0·5 or 1·0 hour washing period was usually most economical in time.

2. Alternate wetting and drying brings the copper to the surface much more rapidly than chemical diffusion. Extractions of 50 and 90% of the total water-soluble copper were obtained in 8 and 71 hours respectively in chemical diffusion tests while the same percentage extractions were obtained in 2 and 17 hours by alternate wetting and drying, when the cycle consisted of a 0·5-hour wash and a 1·0-hour dry.

3. In the shorter drying periods the rate of extraction was nearly the same for 2 and 3 in. pieces, a little slower for the – 1 + ¾ inch size, and considerably slower for 5 to 6 in. pieces. In the longer drying periods, in which the surfaces of the smaller pieces had an opportunity to dry completely, the larger pieces the slower the extraction.

4. The rate of extraction is more rapid at 35° C. than at room temperature (21 to 25° C.). Likewise, at room temperature the rate of extraction is increased when a stream of air is blown over the particles of ore in drying.

5. In the chemical diffusion tests, the rate of diffusion was virtually the same when the ore was impregnated in 8·0 and in 5·0% copper solution, but the rapidity of diffusion was greater than when the impregnating solution contained 2·0 or 0·5% of copper.

6. The rate of diffusion was not markedly different when the same solution surrounded the ore during the entire diffusion test and when an entire new body of solution was used after each sample was taken.

7. The possible employment of alternate wetting and drying for washing in vat leaching.

THE OPERATION OF PRESSURE FANS IN SERIES

The operation of pressure fans in series is discussed by W. S. Weeks and V. S. Grishkevich in Technical Publication No. 339 of the American Institute of Mining and Metallurgical Engineers. The authors state that considerable difference of opinion seems to exist as to whether the rate of air flow when a fan is placed on a given duct should be determined by the use of static pressure or total pressure characteristics and that a little study will show that both methods are correct.

Assuming that a fan is connected to a duct by an expansion piece as shown in Fig. 1, and that steady flow is established, and considering the atmospheric pressure as zero pressure, let the static head at the outlet of the fan be h and the velocity at this point be v_1. The total head at the outlet is then $h + \frac{v_1^2}{2g}$. The total head at this point must be equal to the total head at the end of the duct plus the losses that have occurred between the two points. Let f be the friction loss in the straight duct, s the shock loss in the diffuser, and v_2 the velocity at the end of the duct. Then $h + \frac{v_1^2}{2g} = \frac{v_2^2}{2g} + f + s$. A curve showing the value of the left-hand side of the equation for different rates of flow is the total pressure characteristic of the fan, while a curve showing the value of the right-hand side is the total pressure characteristic of the duct. If these two curves are plotted on the same chart, the intersection indicates the rate of flow when steady flow is established.

The problem may be considered in another way. The static pressure at the outlet of the fan is the static pressure of the fan and it is also the static resistance of the duct from that point to the end. The friction in the straight duct is f. If the duct were the same area as the fan outlet, f would be the static resistance of the whole duct system. In the present case, however, this resistance is decreased by the change of velocity head into static head in the expansion piece. If conversion were perfect, the static pressure recovered would be $\frac{v_1^2}{2g} - \frac{v_2^2}{2g}$. Owing to the fact that some shock loss (s) occurs in the expansion piece the recovery is $\frac{v_1^2}{2g} - \frac{v_2^2}{2g} - s$. The static resistance of the duct is then $f - \left(\frac{v_1^2}{2g} - \frac{v_2^2}{2g} - s\right) = f - \frac{v_1^2}{2g} + \frac{v_2^2}{2g} + s$. When steady flow is established $h = \frac{v_2^2}{2g} + f + s - \frac{v_1^2}{2g}$. This differs from the total pressure equation only in the fact that $\frac{v_1^2}{2g}$ has been subtracted from both sides. A plot of h against

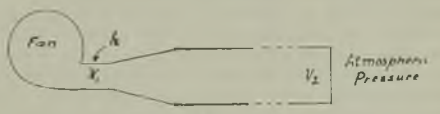


FIG. 1.

rate of flow is the static pressure characteristic of the fan, and a plot of the right-hand side is the static pressure characteristic of the duct. The crossing of these curves will indicate the same rate of air flow as the crossing of the total pressure characteristics.

A recent paper on the subject of fans in series condemns the use of static pressure curves in predicting the performance of fans. The authors can

see no basis for this criticism,[1] as the use of static pressure curves merely eliminates the velocity head at the junction of fan and pipe from both fan and pipe characteristics, in the case of the single fan.

Considering the case of two fans operating in series, as shown in Fig. 2, let the static head at the outlet of the rear fan be h_1, the static head at the inlet of the forward fan be h_2, and the static head at the outlet of the forward fan be h_3. The static resistance of the connecting duct is $h_1 - h_2$. The static resistance of the duct connected to the forward fan is h_3. The total resistance of the duct system is $h_1 - h_2 + h_3$. The static head produced by the rear fan is h_1, and the head produced by the forward fan is $h_3 - h_2$. The static pressure produced by the two fans is $h_1 + h_3 - h_2$, which is identical with the duct resistance.

If, then, the static pressures produced by the fans when in series be added, for different rates of flow, we have the combined static pressure curve of the fans, and if we add the static resistances of the two parts of the duct system, for different rates of flow, we have the static pressure characteristic of the duct system. The crossing of these two curves indicates the rate of flow that will take place.

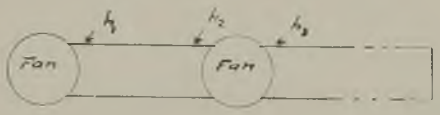


FIG. 2.

The static resistance of a duct is the velocity head at the end, minus the velocity head at the beginning, plus all the shock losses in the duct, plus the friction.

The question now arises, are the static pressure characteristics of the fans the same when in series as when the fans are operating alone? Arguing from theory alone, the rear fan should have the same static pressure characteristic when operating in series as when operating alone, because in both cases it is taking the air from the still atmosphere and raising the pressure in exactly the same way. The forward fan, however, has a distinct advantage. The air is delivered at the inlet by the first fan and so the forward fan is relieved of the burden of accelerating its own air at the inlet. Bernouilli's theorem applied to the flow through this fan shows that if the forward fan is not required to accelerate its own air, it will impress on the delivered air a positive static head greater than it would impress if accelerating its own air, by the amount of the velocity head of the inlet air, it being assumed of course that the fan in the two cases is handling the same amount of air. The forward fan possesses the additional advantage of handling air at slightly higher density. It is also possible that the change in stream lines of the air entering the forward fan and vibrations of the air may have some effect.

Experiments described by the authors were made to determine the effect on static pressure characteristics of placing two fans in series.

APPARATUS.—The arrangement of the apparatus with fans in series is shown in Fig. 3. The fans used were Monogram exhausters, size 0000, made by the B. F. Sturtevant Co. The wheel diameter was 6 in., the diameter of the inlet 3·2 in., the diameter of the discharge 2·75 in. Each fan was connected to the pipe by an expansion piece which was considered a part of the fan, and the increase in static pressure due to the recovery of velocity pressure in the expansion piece was credited to the fan. The fans were belt driven by direct-current motors operated by current supplied by a motor-generator set with voltage control. The exact adjustment of speeds was accomplished by slide-wire rheostats on the motors. Each fan was equipped with a Weston electrical tachometer, the voltmeter of which was placed on the control table near the rheostats.

At the points where static pressure was desired pinhole tubes were inserted. These were connected to a vertical manometer containing alcohol, which could be read to 0·01 in. Velocity was measured

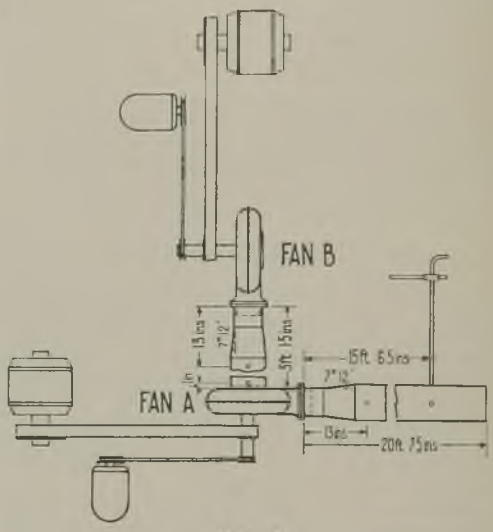


FIG. 3.

with a Pitot tube connected to an inclined manometer with a magnification of 10 to 1. Different resistances were obtained by inserting in the end of the pipe circular wooden blocks containing orifices of different sizes.

TESTS.—The fans were operated at the same speed in all tests, as shown by the electrical tachometers. The speed of both fans was 3,500 r.p.m. Twelve points were taken in each traverse of the pipe for velocity. One man sat at the control table and held the fans at the desired speed while the other man read the manometer. The following tests were made:—

1. Fan A alone with its expansion piece was placed on the duct and its static-pressure-volume characteristic was determined.

2. Fan B alone with its expansion piece was placed on the duct and its static-pressure-volume characteristic was determined.

Within the limits of precision of the instruments employed the characteristics of fans A and B were identical. Characteristics were determined only over the working range of the fans because of the chance of error in measuring lower velocities. In all characteristics the pressures are for a density of air of 0·075 lb. per cubic foot.

[1] E. G. McElroy and A. S. Richardson: Experiments on Mine-Fan Performance, U.S. Bur. Mines *Tech. Paper* 447.

3. Fan B was set to blow directly into the inlet of fan A through a short piece of pipe as shown in Fig. 3.

The pressure produced by fan B was measured at its outlet at point shown. The pressure produced by fan A was measured between the inlet and outlet at points shown. The sum of the two fan pressures is equal to the drop in pressure in the outlet duct plus the drop in pressure in the connecting duct, in other words, is equal to the total duct resistance. A drop in pressure in the connecting duct was discernible only at the highest velocities.

RESULTS.—The characteristics of fan A or B operating alone is shown as the middle curve of Fig. 4, which shows the comparison of the individual fans when operating alone and in series.

The characteristic of fan A operating in series is higher than when the fan was operating alone, as would be expected, while the characteristic of fan B is lower in series. The behaviour of fan B in series indicates that some interference

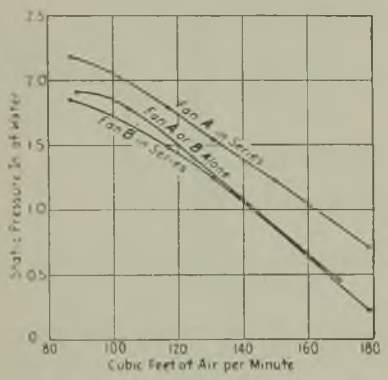


FIG. 4.

was caused by Fan A, as possibly vibrations of the air which affected conversion in the expansion piece.

Fig. 5 shows the increase in static pressure of fan A in series plotted as a percentage of velocity-pressure at its inlet. The gain in pressure is in general more than the velocity-pressure supplied at inlet by fan B, and is greatest when the pressure at the inlet is highest. This indicates that filling the fan blades with air from another machine has a favourable effect on the operation of the fan.

The upper curve of Fig. 6 is the actual pressure-volume characteristic of the fans in series as determined by experiment. In all curves the points marked by a circle were determined by measurement both of pressure and volume.

The lower curve of Fig. 6 is a synthetic characteristic made by adding pressures at like volumes from the characteristics of fans A and B operated singly.

The excess of pressure of the actual characteristic over the synthetic characteristic amounts to a little more than the velocity pressure at the inlet of the forward fan over most of the range tested, so it would seem reasonable in estimating the pressure volume characteristic of two fans in series to add this velocity pressure to the combined characteristic obtained from the fans when operating alone.

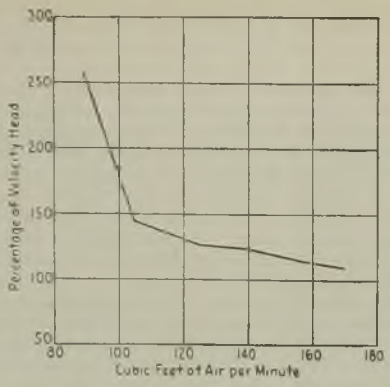


FIG. 5.

If this is done the equation of flow is

$$h_a + h_b + \frac{v_2^2}{2g} = \frac{v_4^2}{2g} - \frac{v_3^2}{2g} + \frac{v_2^2}{2g} - \frac{v_1^2}{2g} + f + s.$$

Where h_a and h_b are the static heads of the fans when running alone, for the quantity involved, v_1 is the velocity at the outlet of the rear fan, v_2 is the velocity at the inlet of the front fan, v_3 is the velocity at the outlet of the front fan, v_4 is the velocity at the outlet of the forward duct, and s and f are the shock and friction losses in both ducts.

It is seen that $\frac{v_2^2}{2g}$ may be eliminated so the equation becomes

$$h_a + h_b = \frac{v_4^2}{2g} - \frac{v_3^2}{2g} - \frac{v_1^2}{2g} + f + s.$$

A curve of the values of the left-hand side for different rates of flow is the synthetic static pressure characteristic of the fans, and a curve of the value of the right-hand side is the duct characteristic to use with it. The crossing of the curves indicates the rate of flow.

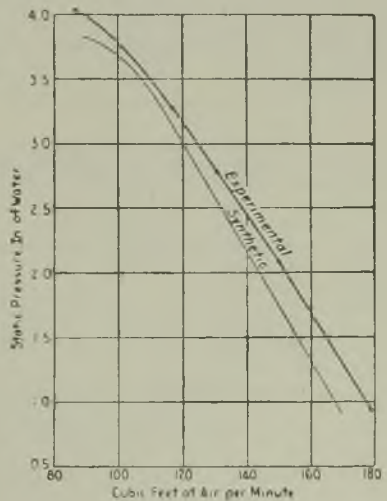


FIG. 6.

THE DISTRIBUTION OF MATERIAL FROM DREDGE SCREEN HOPPER TO JIGS

In the last issue of the MAGAZINE a paper on dredge screening read by O. B. Williams before the meeting of the Malayan Tin Dredging, Mining and Research Association held on March 26, was reproduced in some detail. The author, proceeding from the point reached in that paper, went on to examine the distribution from screen hopper to the primary jigs, considering it well first to examine the method of working, and the conditions ruling, on the jigs.

The primary jigs are run, he stated, to obtain a middling and a residue only, the former containing most of the values. The load is to a certain extent intermittent as the buckets come up full or partly so or containing clay. To obtain the best results from the jigs, setting of stroke, added hutch water, and depth of added "bed" should be altered from time to time to suit the varied conditions. The setting is given after careful observation and sampling with a view to arriving at the mean of the various conditions required, the idea being that during an average daily dredge run of 20 hours, the setting given will be correct for the greater part of the time. Such a theory is based on the fact that the feed is brought onto the jig in the proper manner.

It is a cardinal rule in jigging that the feed should be brought into the jig quietly and evenly distributed over the whole width of the jig screen, and with a proper pulp ratio. It will thus be seen that the method of distribution from the screen hopper to the jig is most important, as the results obtained from the jig are controlled by it. The methods usually adopted vary considerably and a few of them are examined below.

(*a*) *Figures* 1 *and* 1*a* (*Type A*).—These figures illustrate the case in which the hopper slopes with the screen and is in the form of a rectangular box. It has been found that the screen has a tendency to throw more feed to the port side than to the starboard with the normal revolution of the screen, which is clockwise looking forward to the bows. A longitudinal baffle has therefore been put in, slightly to the port side, to compensate for this unequal throw. It happens sometimes that the class of material is "dead" and does not throw so much to port, so that the starboard jigs sometimes receive an overload. The openings to the jig feed launders are through ports in the side and these are at unequal spaces. Cross baffles are placed to keep the material from flowing to the bottom end and to force it through the necessary ports. With the unequal spacing there is a tendency to uneven loading and in the case of the top jigs sprays have had to be introduced to force the feed up to the discharge.

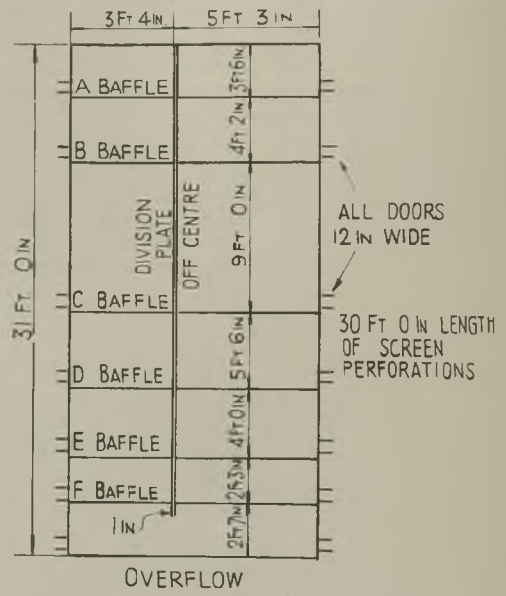


FIG. 1.

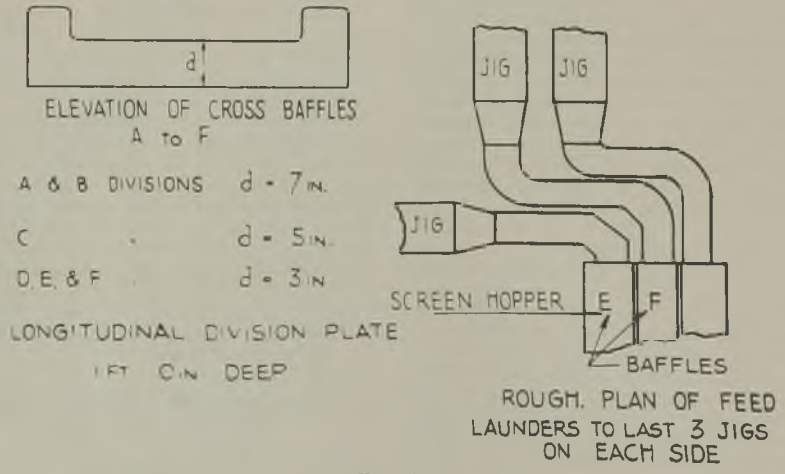


FIG. 1*a*.

As the screen wears, more feed comes through and if it is customary to change the screen lining plates in sections with intervals of time between, then, if the top section were renewed, the top jigs would receive less feed and the later sections heavy feeds.

As the hopper is on a slope the water runs to the bottom end and the feed from the last three ports on each side is accompanied by a tremendous rush of water which will upset the working of the jig, making it impossible to save anything but the coarsest tin. If the ports are closed this water overflows through the opening into the save-all, where any tin carried over with it will be fine and difficult to save. The launders from the hopper to the jig in some cases have bends and only straighten out just prior to entering the jig—this is especially noticeable in the lower jigs—the consequence being that the stream is on one side and cannot be evenly distributed. The doors or ports themselves cause a certain amount of uneven flow, heavy sand oozing from one side and most of the water rushing out from the other corner. These are bad defects, and have been caused through an endeavour to obtain gravity

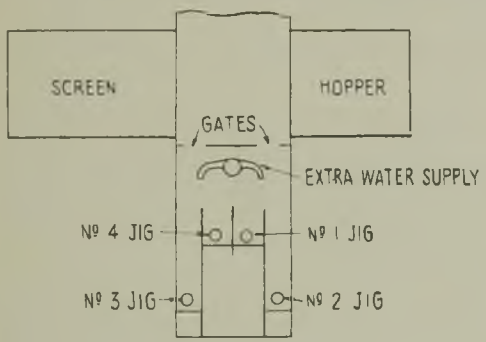


FIG. 2.

feed, no loss of head room, and simplicity of design. These three objects have been obtained, but it is questionable whether they are justified in view of the loss in efficient working. Later designs have improved the spacing and assisted a better distribution.

(*b*) *Figure* 2 (*Type B*).—In this case the hopper slopes gradually towards the centre, the material not being discharged directly to the jigs, but discharged to a launder running athwart ship. This launder on each side runs into a control box, where the surplus water is run off, and the solids drawn off by spigots to the various jigs, easily operated gates regulating the flow evenly to port and starboard and between the jigs. Any extra water which may be required is admitted at the head of the control box. The jigs are placed fore and aft on each side of this box and the feed launders have a straight run, the feed entering the jig without undue rush and evenly distributed.

In this arrangement there is very little loss of head, but the middlings from the jigs have to be lifted to the clean-up jigs. It would be interesting to find out whether the loss of head was counteracted by increased lift of the buckets so that the outboard sand chutes should not be too low, and if so what this addition to the height of delivery of the buckets meant in capital cost of the dredge.

The gates leading to the control box are two in number and divide the feed into the main divisions of the box. There should be a gate again breaking up the flow to each side in such a way as to divide the feed equally between both jigs.

The advantages of this type of feed are:—(1) Extra water can be controlled easily. (2) There is ample space in full view at the head of the box to allow of operation of gates to obtain an even distribution of the feed to the jigs by means of baffles. (3) All the feed at all times comes to one common distribution point.

(*c*) *Figure* 3 (*Type C*).—This illustrates a more elaborate scheme than the last, here the screen hopper sloping from both ends, discharges also into a launder running athwart ship. In the hopper there are deflectors to bring the feed to the centre, and a movable gate operated from outside distributes the feed evenly to port and starboard, where it enters the control box. The control box

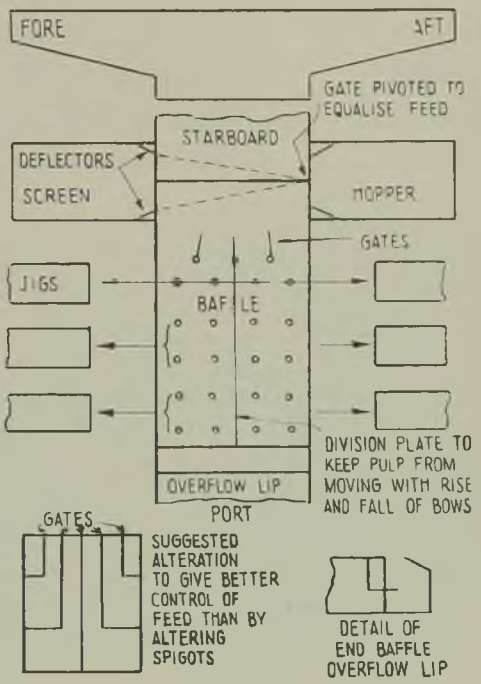


FIG. 3.

has a dividing partition placed longitudinally. This keeps the feed from moving forward or astern as the boat rises by the bows or falls due to the position of the ladder. The total rise or fall is stated to be only $\frac{3}{8}$ in. Gates, by reducing the area prior to entering the control box, help to throw the feed to the far end. A baffle board just past the gates, throws the pulp down and prevents any rush of solids over the discharge end. The feed is drawn from the box by spigots, the size of opening being varied to ensure the even feeding of each jig, the box being baffled at the end as shown in detail Figure 3.

The feed to the two end jigs on either side—all jigs are fore and aft—runs down a launder and has to turn just prior to entering the jig. This tends to cause uneven distribution and has been overcome by guide vanes being brought into the stream which deflect portions down to the jig.

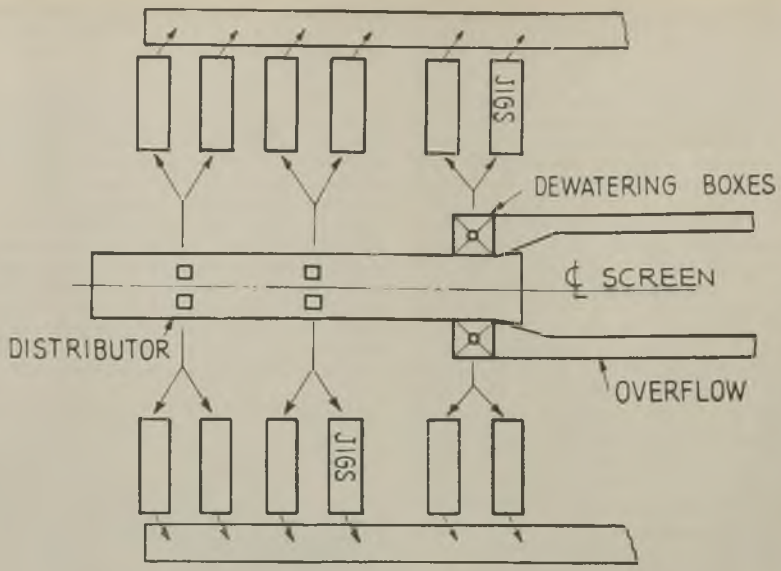


Fig. 4.

There is again a certain loss of head, the middling being elevated to a cone before being fed to the clean-up jigs. The use of baffles to increase the velocity of flow and to force the solids to the far end is not good milling practice, as in all dewatering systems reduction of velocities is essential for good work. It would have been better to have divided each side of the control box forward and aft of the central partition into three divisions, one to each jig spigot by means of three movable gates which would equalise the feed. This would do away with having to alter the spigot openings. At the same time various portions are accessible, simple in operation and in full view. All the feed is brought to one central point, and the feed brought onto the jigs without undue velocity and evenly spread.

(*d*) *Figures* 4 *and* 4*a* (*Type D*).—This shows a variant of the previous type, the feed from the hopper running down a closed launder. There are spigots in the bottom of this launder. The feed to each spigot is controlled by gates easily operated and by which the feed can be drawn off at will. Each port feed two jigs which in this case are across ship. The end of the launder runs into two dewatering boxes, which catch the fines, which are brought onto separate jigs, the overflow going to the paddock.

This type has practically no loss of head, and the excess water is dealt with efficiently at the far end where it is easily accessible and simple in operation. However the first portion is not very accessible and it is doubtful if good control of distribution is obtained and the lay-out of the jigs appears to be cramped.

(*e*) *Figure* 5 (*Type E*).—This figure illustrates an experimental method, the idea being excellent from the point of view of even distribution of the feed, both in amount and quality, if the underlying principle had been properly understood.

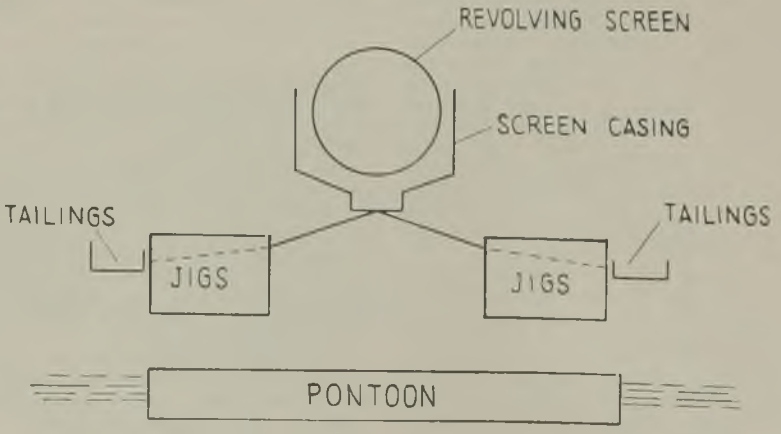


Fig. 4*a*.

The feed from the hopper entered a distributor somewhat on the lines of the Butters and Mein distributors in cyanide vats. The system had, however, only two distributing arms of equal dimensions opposite each other and, instead of relying on the peripheral velocity and the reaction of discharge to revolve the machine, a positive drive was installed. Each distributor fed eight jigs, the feed launders being spaced equally round the circumference. Actually, with two discharges only, two jigs only were fed, as the distributor revolved two others were being fed. Therefore for ¼ of the time of revolution two jigs divided the whole of the feed between them which came on with a rush, while the rest were starved, no control being placed in the launders. The feed was, therefore, irregular and bad.

To obtain results there should have been eight arms, one per jig, spaced at equal distances round the periphery of the distributor. Apart from this, the method meant loss of head and no dewatering control.

The control question has to be considered under the following heads :—(1) Simplicity of operation so as to be easily understood on account of the type of labour employed. (2) Accessibility. (3) In full view while running. (4) Control. Simplicity of design should never be allowed to supplant essentials.

A summary of the various types, examined with respect to the above criteria, is set out below.

The summary indicates that out of 4 systems shown—type E being more an interesting experiment, no sooner put into operation than it was discarded—three incorporate some method of dewatering and control, and the distribution to the jigs in these 4 systems ranges from only fair to good.

If the author's original hypothesis is correct, namely, that no matter how rigid a setting of stroke, speed, added hutch water, and depth of "ragging" given to the jigs the best results are not obtained unless the feed enters the jig correctly, then undoubtedly some method of control is essential both of distribution and dewatering. Of the three systems using some type of control, two obtain results by loss of head, whereas the remaining one retains all the height possible, but loses in accessibility and ease of supervision.

To overcome this loss of head, which affects

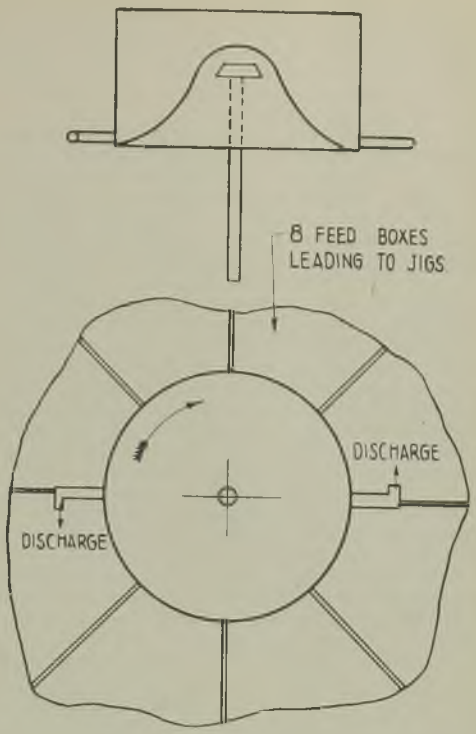


FIG. 5.

the height of the outboard chutes and the lifting up of the hutch product to the clean-up jigs, together with accessibility and ease of supervision, the only method would be to increase the lift of the buckets. This means higher and stronger superstructure, a longer ladder and bucket band. The necessary extra height would be in the nature of 12 ft. for a gravity flow system and 6 ft. where the hutch products are lifted up to the clean-up jigs again.

The 12 ft. may appear to be high, but it will be necessary to place a dewatering cone in front of the clean-up jigs especially as in many cases

Type.	*Screen Hopper Baffles.*	*De-watering System Control.*	*Distri-buting System.*	*Accessi-bility.*	*Simpli-city of opera-tion.*	*Clear View.*	*Loss of Head.*	*Gravity Flow to Clean-up jigs or Pump.*
A	Yes.	Nil.	Only Fair.	Good, but for Screen Hopper.	Very Fair.	Yes, but for Hop-per.	No.	Gravity.
B	No.	Yes.	Good.	Good.	Very Fair.	Yes.	Yes.	Pumps.
C	No.	Yes.	Very Fair.	Good.	Very Fair.	Yes.	Yes.	Pumps.
D	No.	Yes.	Very Fair.	Not Good.	Good.	No.	No.	Pumps.
E	No.	No.	Bad Design.	Not Good.	Good.	No.	Yes.	—

the grade of the launders carrying this product is too low, necessitating added water just where it is not wanted. With a free running quartz tailing a grade of 1 in 8 is permissible, whereas with a "dead" product, such as the one under discussion, 1 in 6 is more in order.

The capital cost of this extra height may be considerable, involving stronger structural details, and more powerful bucket engines or motor, but once installed, maintenance of a few extra buckets being the main charge, an improved recovery of even 2% on a property producing 1,000 piculs a month would show an ample profit throughout the life of the property.

Personally, the author favours a smaller lift to keep the out-board chutes high and to give the necessary accessibility and easy supervision, combined with pumping the hutch products up to the clean-up jigs, thus maintaining full control. Pumps give but little trouble, the upkeep cost of pumping this class of material should be small and, as the return products from the last hutches from the clean-up jigs have to be lifted back onto the jig, the one unit can do both jobs. By such a theme, provided the products from the screen hopper are brought to a central point, the following results are obtained :—(1) Regulation of distribution to port and starboard ; (2) A method of distribution to the jigs which is simple in operation under good supervision. (It would be best to use separate cones for each jig rather than one control box. The gates opening to the control box would then open into launders feeding the cones, such a scheme would increase control and give better results.) ; (3) Accessibility, and (4) Control of all excess water.

Whether alterations to existing plants to incorporate some such scheme as is suggested are justified can only be proved by most careful sampling to establish the true losses. If they are small the benefits to be obtained by any alteration may not justify the capital cost involved. Should they be large then it is a question as to the amount or increase in recovery which might be expected and its value to the company compared with the capital cost, labour and maintenance charges involved. The question of sampling is important, the method adopted by many companies being open to grave suspicion. The only reliable sample is obtained by taking a timed sample which, for that time, takes everything without splash or overflow, a series of these over a period, showing the value and quantity of the feed and residues, will give the true recovery.

An experiment was recently run, testing the usual method of running a sample tin across the lip of a board over which the tailings flowed, against a timed sample, taking the whole flow without splash. The results indicated that the sample can was an incorrect sample, varying above and below the other as was anticipated.

THE HERCULES CUSTOM MILL

The thirty-first annual report on the mining industry of Idaho for the year 1929 contains a description of the Hercules Custom Mill, by H. L. Day, of the Hercules Mining Company. The writer says that the Hercules Custom Mill is located at the western limits of the City of Wallace, Shoshone County, Idaho. The concentrator, originally of 300 tons capacity, was built in 1910–11 to handle the output of the Hercules mine, seven miles to the north-east, near Burke, Idaho. The plant was enlarged from time to time until in 1917–18 more than 1,000 tons were milled daily. The first flow-sheet, embracing straight gravity concentration, was altered as new developments in wet metallurgy took place. When the Hercules ore-body was exhausted in the spring of 1925, the flow-sheet consisted of crushing, jigging, grinding, and tabling ; regrinding, floating, and tabling ; re-regrinding and floating. Only one product was recovered, a silver-lead concentrate.

After the Hercules mine was shut down in April, 1925, the availability of a small tonnage from the Ambergris mine revealed the fact that a substantial demand existed for a custom concentrator. Accordingly, the Hercules Mining Co. began the rehabilitation of the Wallace mill into a custom plant. Commencing in 1926, provision was made for the differential separation of lead and zinc by the construction of a new flotation unit. A second section was added in the spring of 1928, and a third during the summer of 1929. These and other comprehensive alterations, proceeding for more than three years, have changed the mill from a gravity concentrator to an all-flotation plant. The new flow-sheet is much simpler than the old. It may be divided into four parts : Crushing, grinding, floating, and drying.

Crushing.—Ore from the mines is brought to the head of the mill on a high-line spur of the Northern Pacific Railway. It is dumped into any of five bins available, holding 10, 7, 5, 5, and 6 railroad cars, respectively. Individual ores are kept separate in the crushing department, so that the proper samples may be procured. Ore is fed from the bins by impact feeders on to conveyor-belts, which lead past a magnet for removing tramp iron, to an electrically vibrated screen with 1 in. clear openings. The over-size drops through a 9 by 15 in. Blake type jaw-crusher, set to — 3 in., and then passes through a 24 in. horizontal disc crusher, set to discharge — 1 in. material. The crushed oversize then joins the undersize from the screen, and after sampling, both are dropped on to the ball-mill bin shuttle-conveyor.

The original mill-feed, crushed to 1 in., is sampled automatically by a bucket-and-chain sampler. Cuts are made every 25 seconds, amounting to one-ninetieth of the original feed. This one-ninetieth is fed to small rolls, reducing it to ½ in. Next, a Vezin sampler rejects three-fourths, and the remaining one-fourth is reduced by a second set of rolls to ¼ in. About four-fifths is then rejected by a second Vezin sampler ; and the remainder, amounting to approximately 1/360 of the original feed, is split by hand until a suitable weight is reached for the assay office.

Grinding.—Ore from the crushing department is distributed by means of a shuttle-conveyor into the ball-mill bins. These are six in number, and each holds about 12 hours' supply for one ball mill. Short belt-feeders supply the six mills at a constant rate. All the mills are cylindrical in shape. Five are 7 ft. by 7 ft., driven by 125 h.p., slip-ring motors, speed 440 r.p.m. ; the sixth mill is 6 ft.

by 7 ft. with a 75 h.p. motor. Herringbone gears and pinions are employed to give a reduction of 20 to 1. Each of the mills is in closed circuit with a classifier to provide a uniformly fine grind. Four of the classifiers are of the reciprocating rake type, 6 ft. by 20 ft. One of the same type is 8 ft. by 20 ft., and the last is a 20 in. plain drag. The usual density of the mill discharge is about 70% solids. The classifier overflow approximates 30% solids, with 75 to 80% – 200 mesh. These are average figures, which will vary considerably for the different ores treated.

Floating.—The flotation department is divided into three sections, similarly arranged, so that a differential lead-zinc separation can be made on each. Mechanically agitated cells are used for the roughers, and pneumatically agitated for the cleaners. Section One consists of 12 Fahrenwald-type cells with 18 in. impellers, and 10 Minerals Separation-type cells with 18 in. impellers. The second section consists of 24 Minerals Separation-type cells with 18 in. impellers. Section Three has 28 Fahrenwald-type cells with 24 in. impellers. The general practice is to double-clean the rougher concentrates with pneumatic machines of a type developed at the Hercules mill. Section Three is equipped with a regrinding unit, consisting of a thickener and a small ball mill, operating in closed circuit with a bowl classifier. This unit is used for the regrinding of middlings of ores that require exceptionally fine comminution.

Sampling of the various flotation products is done chiefly by mechanical pulp-cutters, although hand methods are also in use. The bulk of the reagents are fed by mechanical means, automatic feeders gradually being installed to supplant the drip buckets. The reagents are fed dry as far as possible, although wet feeding is found to be the more satisfactory in some instances.

Drying.—The lead concentrates are pumped to a thickener, 54 ft. in diameter, and dewatered on two drum-type filters, 8 ft. by 6 ft. The zinc concentrates are dewatered by two thickeners, each 30 ft. in diameter, and one drum-type filter, 8 ft. by 6 ft. The filtered concentrates are carried by inclined conveyors to separate bins, and loaded in box-cars or gondolas on railroad track scales.

The mill is heated by a 60 h.p. boiler, fed with slack coal by a mechanical stoker. It is necessary to maintain in conjunction with the milling operations a complete assay office, as well as a testing laboratory. In addition, a well-equipped machine shop, a carpenter shop, and a pipe shop are provided. A new change-room with showers completes the facilities.

Custom milling requires special care in weighing, moisturing, and sampling. Ore destined for the Hercules mill is weighed on Northern Pacific track scales, which are regularly inspected and tested. The moisture determination is made at the mill, following standard practice. The sampling is all performed mechanically, using modern accepted equipment.

The development of the custom business has resulted in the shipping of a great variety of ores to the mill for concentration. The ores treated have included these types: Silver-lead; silver-lead-zinc; slimes; and reclaimed tailings, a large part of which are oxidized. Experience has shown that it is not feasible to bed or mix these widely differing ores to provide a uniform mill-feed. Hence each lot is treated separately. Naturally this means considerable difficulty in handling small lots and requires far more than the usual skill in operation and detail in supervision. This fact may be readily seen when it is noted that the usual practice is to grind and float three different ores simultaneously, each calling for its own pulp densities and reagents. It was found necessary to make many changes to render the flow-sheet flexible enough to overcome in some measure the difficulties due to the variety of ores.

REPRESSURING A TEXAS OIL POOL

In Technical Paper 470, of the United States Bureau of Mines, entitled "Results of Air Repressuring and Engineering Study of Williams Pool, Putnam-Moran District, Callahan County, Texas", the author of the report, H. B. Hill, arrives at conclusions which are summarized below.

The Williams pool, with 61 producing wells and 9 input pressure wells, showed an estimated gain in production over what have been expected from normal production, of 33% under repressuring methods during 1927, 78% in 1928, and 76% in 1929. The initial production of wells in this pool ranged from less than 4 to 35 barrels, with a daily average of 12 barrels. The estimated net increase for the field over the 3½-year period is 57,500 barrels, or 44%. The pool is one of a number of shallow pools in the lenticular sands of the Cisco series in the Putnam-Moran district. The outstanding features of the pool are the abrupt variation in sand conditions, the absence of pronounced edge-water encroachment, the irregular oil-water contact, and the "low-head" and "small-volume" water that occurs apparently in the base of the sand in the "lows" of areas of depression.

The conclusions of the author are based upon a detailed study of repressuring operations in this pool. Other shallow pools in the Putnam-Moran district have many similar features and characteristics. It is held that old development records are sometimes inadequate or unreliable, and it is often advisable to drill 5-spot wells and core the sand to ascertain subsurface conditions and to obtain other data regarding drainage, porosity, saturation, fluid levels, reservoir pressure, and water conditions. Five-spot wells were drilled for this purpose in the Williams pool and cased to make them input pressure wells. This procedure gave satisfactory results.

The practice of coring with cable-tool equipment has been adopted by several of the companies. Coring has supplied data that can be used more accurately to interpret the character of the producing sands and has facilitated the application of proper development methods and production practices, including restoration measures.

The gravity of the oil in the Williams pool was lower from the beginning of production than that of oil from wells in the surrounding pools. The use of air in this pool has lowered the gravity from 33·3 to 31·8° A.P.I. during approximately 18 months. The average gasoline content of the air-gas mixture taken at the casing head of four wells in the pool during November, 1927, was 1·1 gal.

per 1,000 cu. ft. Fifteen samples collected later from representative wells in the different pools in the district that were also under repressuring operations showed an average gasoline content of 0·796 gal. per 1,000 cu. ft. Before application of air very little, if any, gas was produced at the casing heads. The gas-oil ratios during the flush periods in the shallow pools of the district are usually small, and when repressuring commenced these ratios were probably below 500 cu. ft. per barrel of oil. Methods of repressuring that favour the maintenance of a low gas-oil ratio (approximately 1,000 cu. ft. or less per barrel of oil) are desirable and aid in conserving the repressuring medium by preventing by-passing.

The use of air for repressuring or the circulation of an air-gas mixture of high air content aggravates corrosive action Brass and bronze working parts are now generally used in the pumping equipment in the pools of this district wherever possible. Gas, when available, is probably a better repressuring medium, because it is more soluble in oil and its corrosive action is less. The recycling of casing-head vapours with gas for make-up purposes has given satisfactory results on a number of properties in the district. The use of all vapours produced with the oil is a conservation measure and tends to prevent loss in the gravity of the oil.

During the early development of the shallow pools some wells were completed to produce from one or more sand lenses and a considerable depth of open formation was left in the bottom of the hole. In other wells pockets were drilled below the pay horizons. Although these methods of completing wells may not appear detrimental to production when a well is completed, later they may constitute a hazard, especially under repressuring operations. The best practice requires close isolation of the pay sand. If there is a barren formation or water zone below the producing sand the hole should be plugged back to the bottom of the pay horizon, or if a barren formation or gas sand occurs above the "pay" the wells should be properly cased before repressuring is begun.

The sand conditions in several of the shallow pools under observation were as follows: Free gas occurred in the upper part of the zone, and below this zone in sand probably 6 to 10 ft. thick the best "pay" was found. A low-head small-volume water was encountered in the base of the sand over parts of the pools. At relatively low pressures the repressuring medium passed more freely through the depleted gas sand than through the oil sand or the less-saturated parts of the water sand. This condition may be helped or partly overcome by shutting in the wells or maintaining a high fluid level.

Restoration of pressure in the producing zone tends to retard encroachment of water, especially in the lenticular sand areas of low-head small-volume waters. The presence of small volumes of gas in the shallow pools of this district suggests that low initial production is caused by lack of enough expelling force in the reservoir sand to move appreciable amounts of oil into the hole. Repressuring methods offer a logical means of supplying the additional energy necessary for a higher recovery. The gravity and viscosity of the oil, the amount of gas in solution, the permeability and porosity of the sand, and the character of the sand reservoir influence the results and largely determine the most suitable operating plan.

Uniform distribution and spread of the repressuring medium are advisable, but are generally difficult to obtain, especially where there are several operating units. Leases in some of the pools have therefore been consolidated, a condition that permits greater freedom in choosing a plan of operation. Co-operative development, involving uniform practices, has given satisfactory results. By-passing is controlled by regulating the input volume, holding back pressure at the casing head of the producing wells, adjusting the rate and stroke in pumping equipment, raising tubing, and properly timing the intermittent pumping and rest periods.

The selection of input wells in the Williams and adjacent pools to give greatest recovery probably depends more upon the number of producing wells that may be affected by air injection than upon the following factors: The position of the wells on the structure, the distance of the input well from lease boundary lines, the mechanical conditions of the wells, and their past production history. In these shallow pools the average ratio is 1 input well to 6 producing wells.

The pressures necessary to deliver a given volume of air or gas to the sand in the pressure wells of a pool and in various pools vary considerably. In this district approximately 20,000 to 30,000 cu. ft. of gas is delivered to the sand through each key well daily at whatever pressure is needed to inject this amount into the producing formation. Forcing the daily production by high-power injection methods increases by-passing and is detrimental to uniform distribution and spread of the repressuring medium. A gradual increase in production over a long period of time under repressuring practices is believed to be desirable and will result in a higher ultimate recovery. Attention is called to the importance of accurate observations and records of production data, including input and output air-gas volumes and pressures, and to the necessity of installing proper equipment and recording devices for obtaining these data. Experimental tests at the individual wells with portable compressors offer a practical method of obtaining pressure-volume data for planning permanent installations.

Sands in the Cisco series in several shallow pools in this district have been successfully repressured. Three of the larger pools for which figures are available and on which air was applied during 1926 showed gains in production of 300,286, and 118% respectively for the year 1927. The average daily production per well for the month prior to repressuring in the three pools was 1·2, 1·3, and 2·9 barrels, respectively.

Cadmium, Magnesium and Mercury in the United States.—The production of metallic cadmium in 1929 amounted to 2,481,427 lb., valued at $2,009,956, as reported by producers to the United States Bureau of Mines, Department of Commerce. This is an increase of 32% in quantity over the production of 1,875,896 lb. in 1928, which was 75% higher than production in 1927 and prior to 1929 the largest annual production on record. The average value reported by producers in 1929 was 81 cents per lb. compared with 61 cents per lb. in 1928. There were 214,307 lb. of cadmium, valued at $184,527, imported into

the United States during 1929, compared with 233,101 lb., valued at $128,901, in 1928.

The domestic output of new magnesium ingot increased from 521,075 lb. in 1928 to 1,329,669 in 1929, or 155%. Magnesium has become a commercial material of substantial importance. Price reductions of 5 to 20 cents a pound, which became effective in January, 1930, now place this metal on a competitive price basis with other light metals. During the last two years the domestic output of primary magnesium has been all obtained from magnesium chloride recovered as one of the many co-products of the extensive industry based on the brine wells at Midland, Mich. The manufacture of ingot magnesium by the oxide process has been suspended. The marketed production of manufactured magnesium other than ingot as reported by the leading companies for recent years amounted to 196,321 lb. in 1929 compared with 137,232 in 1928 and 85,895 in 1926. Magnesium imported for consumption in 1929, according to the records of the Bureau of Foreign and Domestic Commerce, amounted to 3,490 lb., valued at $6,539, and included alloys, powder, sheets and tubing.

The production of mercury in 1929 amounted to 23,682 flasks of 76 lb. each. The calculated value of the production, using the average price of mercury during the year, is $2,892,638. This is the largest production since 1918 when 32,450 flasks was produced, but is only about 73% of the average annual production from 1850 to 1921, inclusive. The incentive to produce was greater in 1929 than during the period 1850 to 1921 as the average quoted price was approximately $122 a flask, compared with $48 a flask for the period 1850 to 1921. The production of mercury in 1928 was 17,870 flasks of 76 lb. each, having a calculated value of $2,207,003. California again led the mercury-producing States in production in 1929 with an output of 10,139 flasks, Nevada was second with 4,764 flasks, followed by Oregon with 3,657 flasks. In 1929, 14,292 flasks, valued at $1,447,142, were imported, compared with 15,378 flasks, valued at $1,572,017, in 1928.

SHORT NOTICES

Automatic Hoisting.—The variable voltage system of electrical hoisting as installed at the Emma Nevada shaft of the Consolidated Coppermines Corporation is described by J. E. Borland in *Engineering and Mining World* for July.

Asbestos Mining.—*Engineering and Mining World* for July contains an article by Dr. W. Kupferburger on mining amosite asbestos in the Pietersburg district of South Africa.

Waelz Process.—A brief description of the Waelz process for the recovery of zinc from ores or slags is given by B. H. Strom in *Engineering and Mining World* for July.

Electro-Galvanizing of Steel Wire.—A process for the electro-galvanizing of steel wire has been evolved at the works of Whitehead, Hill and Co., at Cwmbran, Mon., and it is described in *The Iron and Coal Trades Review* of July 18.

Fuller's Earth.—The mining and manufacture of fuller's earth at Attapulgus, Georgia, is described by H. D. Keiser in *Engineering and Mining World* for July.

Magnesite in Assaying.—R. J. B. Kethel outlines the applications of magnesite in assaying in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa for May.

Colorimetric Assay of Titanium.—The use of potassium-titanium oxalate for the preparation of a standard titanium solution in colorimetry is described by W. M. Thornton, Jr., and R. Roseman in the *American Journal of Science* for July.

Microscopic Analysis.—"Quantitative Microscopic Analysis and its Application to Mining Problems" is the title of a paper by J. E. Thomson in the *Canadian Mining and Metallurgical Bulletin* for July.

Solution Pressure in Ore Deposition.—Ore deposition in open fissures formed by solution pressure is discussed by A. Wandke in Technical Publication No. 342 of the American Institute of Mining and Metallurgical Engineers.

Geophysical Prospecting.—Technical Publication No. 330 of the American Institute of Mining and Metallurgical Engineers contains a description of a new geophone by C. A. Heiland.

Prospecting.—The unexpected in the discovery of ore-bodies is discussed by I. B. Joralemon in Technical Publication No. 340 of the American Institute of Mining and Metallurgical Engineers.

Quicksilver Ore-Bodies.—C. N. Schuette describes the occurrence of quicksilver ore-bodies in Technical Publication No. 335 of the American Institute of Mining and Metallurgical Engineers.

Age Relationships at the Aldermac Mine, Quebec.—New data on the age of the sulphide ore at the Aldermac mine are given by H. C. Cooke in the *Canadian Mining Journal* for July 4.

Coronation Gulf Copper Deposits.—L. T. Burwash reports on explorations during 1928 and 1929 in the copper-bearing areas around Coronation Gulf in the North West Territories of Canada in a booklet issued by the North West Territories and Youkon Branch of the Department of the Interior, Ottawa. The report is summarized in the *Canadian Mining Journal* for July 4.

Amulet Mine, Quebec.—A description of the geology and ore-relationships at the Amulet mine is given by H. C. Cooke in the *Canadian Mining and Metallurgical Bulletin* for July.

Lake George Mine, N.S.W.—E. C. B. Heden describes this lead-zinc mine in the *Chemical Engineering and Mining Review* of Melbourne for May 5.

Coxheath Copper Mine, Nova Scotia.—The Coxheath mine, in Cape Breton county, Nova Scotia, is described by W. W. Beaton and F. J. Sugden in the *Canadian Mining and Metallurgical Bulletin* for June.

RECENT PATENTS PUBLISHED

☞ *A copy of the specification of any of the patents mentioned in this column can be obtained by sending 1s. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.2, with a note of the number and year of the patent.*

6,150 of 1929 (307,345). W. Bachman, Hanover. Simple and double aluminium fluorides and aluminium oxides suitable for the production of aluminium metal are prepared by first forming a basic solution containing aluminium nitrate and then adding solid or dissolved alkaline fluorides.

6,324 of 1929 (330,257). Y. Kato and K. Yamamoto, Japan. Improvements in the manufacture of manganese dioxide.

6,358 of 1929 (329,962). METALLGESELLSCHAFT A.-G., Frankfort-on-Main, Germany. Hot gases, such as blast furnace gases, are purified by first passing through a heat-exchange cooler placed before an electrical precipitor, the latter being of such a length that readily precipitatable spray is first removed and the less readily precipitatable dust removed in a dry condition in a later part.

7,909 of 1929 (308,256). R. AMBRONN, Gottingen, Germany. Improvements in geophysical processes involving the use of alternating electrical currents of very low frequency.

8,366 of 1929 (330,317). SIEMENS-SCHUCKERTWERKE A.-G., V. GUTMANN, and L. STEINER, Berlin. An electro-magnetically controlled device for taking liquid samples from bore-holes or shafts.

8,931 of 1929 (330,661). W. J. MULLER and H. HILLER, Vienna. An improved process for the preparation of alumina.

14,223 of 1929 (330,715). KALI-FORSCHUNGS-ANSTALT G.m.b.H., Berlin. Magnesia is prepared from magnesium salts by saturating the requisite salt solutions with ammonia and separating the magnesium hydrate precipitated thereby.

18,746 of 1929 (314,526). A. KARL, Marseilles. The production of zirconium oxide from zirconium minerals.

20,760 of 1929 (330,163). DORMAN, LONG AND CO., LTD., Middlesborough and M. R. KIRBY, Durham. Improvements in dust collectors and separators.

NEW BOOKS, PAMPHLETS, Etc.

☛ Copies of the books, etc., mentioned below can be obtained through the Technical Bookshop of *The Mining Magazine*, 724, Salisbury House, London, E.C. 2.

Mine Atmospheres. By W. PAYMAN and I. C. F. STATHAM. Cloth, octavo, 336 pages, illustrated. Price 10s. 6d. London: Methuen and Co.

Belting and its Application. By J. DAWSON, JR. Cloth, octavo, 194 pages, illustrated. Price 10s. 6d. London: Chapman and Hall.

Geology and Minerals of Manitoba. By Dr. W. L. GOODWIN. Cloth, pocket size, 260 pages, illustrated. Gardenvale, Quebec: Industrial and Educational Publishing Co.

Geologische Karte der Erde. Lieferung 2. Blätter 5, 6, 9, 10. Scale $\frac{1}{15,000,000}$. Subscription Price 150 marks. Berlin: Gebrüder Borntraeger.

Geological Survey of England and Wales. Alnwick (Holy Island) Sheet 6. Drift and Solid, price 2s. each. London: H.M. Stationery Office.

British Columbia. Annual Report of the Minister of Mines for 1929. Cloth, quarto, 532 pages, illustrated. Victoria: Bureau of Mines.

Geology of the Eagle–Circle District, Alaska. United States Geological Survey Bulletin 816. By J. B. MERTIE, JR. Paper backs, 166 pages, illustrated, with map. Price 50 cents. Washington: Superintendent of Documents.

Mining in the Fortymile District, Alaska. United States Geological Survey Bulletin 813–C. By J. B. MERTIE, JR. Mineral Resources of Alaska 1928 (pp. 125–42). Price 5 cents. Washington: Superintendent of Documents.

The New World or Cooke City Mining District, Park County, Montana. United States Geological Survey Bulletin 811–A. By T. S. LOVERING. Contributions to economic Geology, 1929, Part I, pp. 1–87. Price 50 cents. Washington: Superintendent of Documents.

Geology and Coal Resources of the Meeker Quadrangle, Moffat and Rio Blanco Counties, Colorado. United States Geological Survey Bulletin 812–C. By E. T. HANCOCK and J. B. EBY. Contributions to economic geology, 1929, Part II, pp 191–242. Price 30 cents. Washington: Superintendent of Documents.

Geology and Oil Resources along the Southern Border of San Joaquin Valley, California. United States Geological Survey Bulletin 812–D. Contributions to economic geology, 1929, Part II. pp. 243–332. Price 50 cents. Washington: Superintendent of Documents.

Borate Minerals from the Kramer District, Mohave Desert, California. By W. T. SCHALLER. United States Geological Survey Professional Paper 158–I. Shorter contributions to general geology, 1929, pp. 137–70. Price 20 cents. Washington: Superintendent of Documents.

Transvaal Chamber of Mines; Fortieth Annual Report, 1929. Cloth, quarto, 212 pages. London: Transvaal Chamber of Mines, Salisbury House.

COMPANY REPORTS

Namaqua Copper.—This company was formed in 1888 to work low-grade copper ore in the Cape Province of South Africa. The report for the year 1929 shows that 2,202 tons of fine copper was produced, a reduction of 289 tons as compared with the previous year, the decrease being due to a decline in the copper content of the ore treated. The net profit for the year was £9,712, which was carried forward. The ore reserves at the end of the year were estimated to be 62,318 tons averaging 3·5% copper, as compared with 72,072 tons averaging 4·42% copper at the end of the previous year.

Mayfair Gold.—This company was formed in 1928 to work a gold property in the Insiza district of Southern Rhodesia. The report for the year ended March 31 last shows that operations were greatly hindered by the breakdown of a portion of the power plant in January last. New plant is being installed. During the period April 1, 1929, to January 15, 1930, 14,025 tons of ore was milled and 6,402 oz. of gold recovered, the loss for the year being £5,296. The ore in sight at the end of the period under review was estimated to be 18,500 tons averaging 15 dwt.

Luiri Gold Areas.—This company was formed in 1928 and works gold deposits at Matala Hill and Dun Robin in Northern Rhodesia. The report for the year 1929 shows that the treatment plant at Matala Hill was closed down in July, 1929, up to which time intermittent operations at the plant had recovered gold valued at £2,373. The plant has been entirely reconditioned and new power and crushing equipment installed, operations restarting in January last.

Tanganyika Concessions.—This company was formed in 1899 and holds large interests in the Union Minière du Haut Katanga, the Benguela Railway and the Rhodesia-Katanga Company. The report for the year 1929 shows that the output of copper of the Union Minière was 136,992 tons of which the greater part was converted into electrolytic. Of this output, 55,955 tons was produced in water jacket furnaces at Lubumbashi, 8,070 tons in the reverberatory furnace at Lubum-

bashi, 61,199 tons in the reverberatory furnaces at Panda, 10,315 tons in the leaching and electrolysis plant at Chituru and 1,453 tons at the metallurgical works in Belgium. The ore reserves in the Congo at the end of the year were estimated to be 78,000,000 tons containing over 5,000,000 tons of copper, although 2,225,000 tons of ore were extracted during the year. Cobalt totalling 700 tons was sold during the year as against 450 tons in 1928 and 60 grammes of radium were sold as against 42 in the previous year. The output of cassiterite was 551 tons and of refined metal 386 tons. As regards the company's other interests, the Benguela Railway was completed to the Angola border and is expected to be connected with the Congo system early in 1931. Progress at the Kansanshi mine of the Rhodesia-Katanga Company has been rapid and it is estimated that there are 8,000,000 tons of ore in sight, which average 4·15% copper. Prospecting is being continued in the Sudan and in Uganda, work on the Kilembe copper mine being said to show interesting results. The accounts show a profit for the year of £473,154, and this, together with £668,069 brought forward, gave an available balance of £1,141,223, of which £413,159 was distributed as dividends, £112,633 transferred to reserve and the balance carried to the next account.

Bisichi Tin.—This company, formed in 1910, operates alluvial tin properties in Northern Nigeria. The report for the year 1929 shows that 979 tons of concentrates were produced, as compared with 398 tons in 1928. The average cost at railhead was reduced from £130 to £75, but the price realized also dropped from £151 to £127. The working profit was £24,078 and, after making provision for depreciation, etc., £21,551 was available for distribution, from which it is proposed to pay a dividend of 5% which will absorb £17,825. The ore reserves stand at approximately 11,285 tons, and additions are expected when prospecting work in hand has been completed.

Ex-Lands Nigeria.—This company, formed in 1912, operates alluvial tin properties in the Bauchi Province, Northern Nigeria. The report for the year 1929 shows that 655 tons of concentrates was produced, as against 650 tons in 1928, the price realized being £123 as against £139. The accounts show a net profit for the year of £17,007 which was carried forward. The ore reserves at the end of the year were estimated to be 6,897 tons. The installation of electrical plant on the property is almost completed and is expected to have a favourable effect on production costs.

Naraguta Durumi Areas.—This company was formed in 1929 to operate alluvial tin property in Northern Nigeria. The report to March 31 last shows that 181¾ tons of tin concentrates was produced during the period, in addition to 32½ tons produced under tribute, the average price realized being £112 per ton. The loss for the period under review was £5,617.

Juga Valley Tin Areas.—This company was formed in 1927 to operate alluvial tin property in Northern Nigeria. The report for the period ended February 28, 1929 shows that 98¾ tons of tin concentrates was produced, the loss on mining operations being £8,043. Additional areas have been acquired by the company.

Junction Tin.—This Company, formed in 1923, works alluvial tin properties in Northern Nigeria. The report for the year 1929 shows a reduced output of 93 tons, 172 tons having been recovered in 1928. The year's operations resulted in a net loss of £3,005. The ore reserves at the end of the year were estimated to be 545 tons.

Tin Properties.—This company was formed in 1912 and in 1924 acquired alluvial tin properties in Northern Nigeria which have been subsequently added to. The report for the year ended September 30, 1928, shows that 41½ tons of concentrates was produced, the total revenue being £5,316, the loss for the year being £1,461. The ore reserves at the end of the period under review were estimated to be 4,000 tons.

West African Diamond Syndicate.—This company, formed in 1923, works alluvial diamondiferous deposits in West Africa. The report for the year ended March 31 last shows that 203,200 carats was produced, as compared with 163,500 carats in the previous eighteen months, the profit being £53,679 as against £34,331. Additional properties have been acquired on the West Coast and, in addition, prospecting is being conducted in South America. During the year £45,337 was distributed as dividends, equal to 15%.

Zinc Corporation.—This company was formed in 1905 and operates the South Blocks mine at Broken Hill. The report for the year 1929 shows that 287,407 tons of ore averaging 15·3% lead, 10·4% zinc and 3·4 oz. silver per ton was sent to the mill where 63,270 tons of lead concentrates, averaging 65·4% lead, 6·9% zinc and 13·8 oz. silver per ton was produced. In the Zinc section 51,557 tons of zinc concentrates averaging 47·5% zinc, 3·3% lead and 1·2 oz. silver was produced. The ore reserve is estimated at 2,707,000 tons as compared with 2,666,800 tons at the end of 1928. On the zinc lode the reserve is estimated at 249,056 tons as compared with 245,696 tons at the end of 1928. The profit for the year was £246,050 from which dividends amounting to £206,434 have been distributed.

Federation Tin Mines.—This company was formed in 1926 and works tin properties in Tasmania. The report for the period ended December 31 last shows that crushing commenced in March, 1929, but owing to faulty design the mill was only able to treat 40 tons per day instead of the 150 tons as planned. In these circumstances it was found impossible to run the mill at a profit until the necessary additional plant could be installed. Up to the end of the year, when work ceased, 9,592 tons of ore was crushed for a recovery of 43 tons of approximately 67% concentrates. Arrangements are in hand whereby it may be possible to arrange for the additional fine crushing plant to be installed, when, it is stated, working costs should not exceed 8s. per ton, which will enable the mine to be worked at a profit.

Blackwater Mines.—This company was formed by the Consolidated Gold Fields of New Zealand in 1906 to work a gold-mine in the Reefton district of New Zealand. The report for the year 1929 shows that 37,744 tons of ore was treated for an output of gold worth £64,394. The working cost was £56,868 and the working profit £7,526. Allowances for depreciation and development left a debit balance for the year £1,685. The estimated ore reserves at the end of the year were 73,500 tons averaging 9·51 dwt.

Kramat Pulai.—This company was formed in 1907 to acquire alluvial tin property in the Kinta district, F.M.S. The report for the year 1929

shows that 224½ tons of tin concentrates, worth £27,232, was recovered during the year, as compared with 182½ tons worth £23,809 in 1928. Tributers produced 160 tons which brought the company £2,602. Work on the scheelite mine recommenced during the year and approximately 300 tons of this mineral were recovered up to the end of the year. This work entailed the reconditioning of the mill, which had been standing idle for over 10 years, a new aerial ropeway, and the provision of a new water supply for the plant. The net profit for the year was £27,290 and £15,000 was distributed as dividends, equal to 15%.

Lahat Mines.—This company was formed in 1906 to acquire alluvial tin property at Lahat, in the Kinta Valley, Perak, F.M.S. The report for the year 1929 shows that the output of tin ore was 189 tons, as compared with 195 tons in 1928. The amount realized was £24,349, and there was an income of £3,671 from tributers. The profit was £5,868 and the amount brought forward from the previous year was £4,267, the amount available for distribution being £10,136. A dividend absorbing £6,000 was paid, equal to 5%.

Southern Tronoh.—This company, formed in 1927, operates alluvial tin property in the State of Perak, F.M.S. The report for the year 1929 shows that No. 1 dredge started recovering tin in May, 1929 and No. 2 dredge in September of the same year. The output of the dredges to the end of the year was 250 tons, which realized £29,632, the loss for the year being £1,737.

Sungei Besi.—Formed in 1909, this company works alluvial tin property in the Kuala Lumpur district, F.M.S. The report for the year 1929 shows that the output of tin concentrates for the year was 554 tons, as compared with 539 tons in 1928, the amount realized being £73,383. The profit for the year was £17,412, to which was added £31,685 brought forward from 1928. Dividends amounting to 12½% were paid which absorbed £18,500. Further property is to be acquired.

Teja Malaya Tin Dredging.—This company was formed in 1925 and works an alluvial tin property in the Kinta district, F.M.S. The report for the year 1929 shows that, after reconstruction, No. 1 dredge restarted in October of that year and that, after temporary repairs, No. 2 dredge worked until September 30, 1929, when reconstruction was started which was not completed until March 24, 1930. In the time available during the period under review the two dredges treated 772,500 cu. yd. of ground and recovered 149 tons of tin concentrates. Working was conducted at a loss as the dredges were not yet on the selected area.

Tronoh Mines.—This company, formed in 1901, works alluvial tin property in the Kinta district, F.M.S. The report for the year 1929 shows that the output of tin concentrates was 1,324 tons which realized £169,404. The profit for the year was £98,863 and £93,368 was distributed as dividends, equal to 32½%. During the year it was decided to capitalize £50,000 standing to the credit of profit and loss account by issuing 100,000 fully paid £1 shares, 10s. to be payable in cash and 10s. as bonus satisfied by the above sum.

Tavoy Tin Dredging.—This company was formed in 1923 and operates alluvial tin property in the Tavoy district of Lower Burma. The report for the year 1929 shows that 1,216,043 cu. yd. were treated by dredge and gravel pump and 567½ tons of tin concentrates recovered, which represents an increase of 53½ tons over the output of the previous year. The gross profit for the year was £47,125 and, after adding £21,144 brought forward from 1928 and deducting expenses, there was a balance of £37,338 available for appropriation. Of this sum £10,090 was transferred to general reserve, £10,500 to taxation reserve and £16,748 was carried forward.

Malaysiam Tin.—This company was formed in February, 1929, and works alluvial tin property in the F.M.S. The report for the period to March 31 last shows that 136½ tons of tin concentrates were recovered, the loss for the period being £2,757. Work on a full scale was impossible before December, 1929.

San Finx Tin.—This company, formed in 1926, works a tin-wolfram mine in North-West Spain. The report for the year 1929 shows that 51,640 metric tons of ore was mined and 43,594 tons milled, resulting in a recovery of 253·5 tons of tin concentrates and 154·8 tons of wolfram concentrates. Proceeds from the sales of concentrates were £46,288, but, after allowing all expenses and depreciation, there was a final loss of £982.

Wheal Kitty.—This company was formed in 1925 to acquire the Wheal Kitty, Penhalls, Wheal Friendly and Polberro mines in Cornwall. The report for the year ended January 31 last shows that 39,980 tons of ore was milled for a recovery of 524·68 tons of tin concentrates, worth £74,391. There was a net working profit of £5,281 which reduced the debit balance brought forward to £7,066. Development was advanced during the year with favourable results.

DIVIDENDS DECLARED

Angola Diamond.—1s., payable July 21.
Ashanti Goldfields.—35%, less tax, payable July 31.
Bisichi Tin.—6d., payable August 8.
Petaling Tin.—5%, less tax, payable July 31.
Wankie Colliery.—6d., less tax, payable July 31.

NEW COMPANIES REGISTERED

Continental and British Mining and Financial Trust.—Registered as a private company July 8. Nominal Capital: £10,000 (8,000 £1 Ordinary and 40,000 1s. Founder's). Objects: To carry on the business of bankers, concessionaires, etc.

Hellin Sulphur.—Registered July 26. Nominal Capital: £260,000 in £1 shares. Objects: To acquire mining rights and metalliferous land in Spain or elsewhere; to adopt an agreement with Senor Diego Martinez; to carry on metallurgical operations, and to carry on the business of mining in all its branches. Office: 16, St. Helen's Place, E.C.

Treasure Mountain Syndicate.—Registered as a private company on July 14. Nominal Capital: £50,000 in 1s. shares. Objects: To adopt an agreement with J. E. Knox, to carry on business as financiers, to acquire and deal with mines and mining rights, etc.

COMPANY MEETINGS AND REPORTS SECTION

ZINC CORPORATION, LTD.

Directors: Sir Robert Horne (*Chairman*), R. W. Skipwith (*Vice-Chairman*), C. L. Baillieu, J. R. Govett, G. C. Klug, Capt. O. Lyttelton, W. S. Robinson (*Managing Director*). *General Managers:* Bewick, Moreing and Co. *Superintendent:* C. C. Freeman. *Secretary:* F. A. Crew. *Office:* 95, Gresham Street, London, E.C. 2. *Formed* 1911. *Capital issued:* £572,261 10s. (245,692 Pref. of £1 and 653,139 Ordinary of 10s.).

Business: Operates the South Blocks lead-zinc-silver mine at Broken Hill, New South Wales.

The nineteenth ordinary general meeting of the Zinc Corporation, Ltd., was held on July 30 at 8, Basinghall-street, E.C., Sir Robert Horne (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year 1929, said: The gross value of our production from the mine last year was just over £1,201,000, and we expended for labour, supplies, services, royalty and taxes about £1,064,000—almost the whole of which was distributed within the Commonwealth of Australia. These figures will give you and others interested in your operations some idea of the importance to Australia of the successful conduct of your affairs, and in particular to the district of Broken Hill. From the directors' report already circulated to you, you will have noted that lead in 1929 was higher by £2 1s. 7d. per ton than in 1928, while silver was 2·48d. per ounce lower. As up to 30th June, 1930, our income was not influenced by spelter fluctuations, you might reasonably have expected our profits on the average metal prices for 1929 to have shown a fair expansion This would have been so but for the fact that the financial crisis in the United States of America—with its immediate and severe repercussions throughout the entire world—resulted in a severe reduction in the demand for lead, thus increasing your stocks, or the stocks held on our account, at the end of December 31 last, to a point which, in your directors' opinion, necessitated very substantial provision being made against depreciation in value on final realization. For all metal in lead concentrates not finally realized and settled for, we took values of £15 for lead and 1s. 6d. per fine ounce for silver. If you remember that on all occasions there is approximately a minimum of five months between production of concentrates and final realization of metal, and that in addition during the last four months of 1929 world purchases of lead were approximately only 70% of normal, you will be able to appreciate the severe effect on our net earnings of our very conservative but absolutely necessary policy of placing these lower values on our production.

I have emphasised this point to you in view of the marked effect produced on our profits. At this juncture, with realizations for 1929 practically complete, I am happy to be able to say that, in spite of the anticipated adverse movement of metal prices, the actual declines have proved to be substantially less than the provisions made.

The net income from our mining department, after deducting all proper charges, was £137,156, against £144,623 in 1928. Our revenue from associated enterprises and from interest and dividends came out slightly higher at £124,830, as against £118,580 in 1928. We are thus enabled, after deducting the usual charges for income-tax and expenses of administration, to show a net profit for the year of £246,050, against £255,534 in 1928. We have set out in detail how we have appropriated this profit, and I have no doubt our disposal of it will meet with your approval. The fixed preferential dividends have been paid as well as the participating dividends to both Preference and Ordinary shareholders amounting to 3s. 6d. per share, against 4s. per share in 1928. The usual appropriations for mine development and new plant have been made, and it is proposed to bring up our general reserve account to £180,000 by the transfer of £21,654 to that account. This will leave a balance to be carried forward of £38,474, against £45,021 in 1928.

As regards our investments in associated companies, our report to you set out what I may term our major interests. They represent a sum of about £357,500 in our books—a figure very much below cost and one which we consider quite safe.

Last year was a record all round at the mine and mill. We mined and milled the largest tonnage in our history and obtained our highest metallurgical recoveries. We also effected a saving in costs. The developments in the mine continue to be excellent, as is shown in Messrs. Bewick, Moreing and Co.'s report, and our recent diamond drilling justifies the statement that the ore bodies extend at least to 2,000 ft. in depth and maintain their extent and value. It is also worthy of note that steady progress has been made with the enlargement and further sinking of Block V shaft, which during the year was carried down to 800 ft. and has now reached 1,300 ft. with great improvement in ventilation and working conditions.

So much for the results of 1929. As to the current year, it is necessary to warn you that the mine revenue, and probably also that from the investment funds, will, for the reasons already given, show material reductions. The average metal prices for the first six months of this year were: Lead, £19 5s. 8d. per ton; silver (fine), 1s. 8·6d. per oz; spelter, £18 6s. per ton; as against averages for the whole of 1929 of: Lead, £23 4s. 11d.; silver, 2s. 2·39d.; spelter, £24 17s. 8d.

Though least in direct importance to us of the three metals we produce, the value of silver plays indirectly a very important part in our affairs, for our metals enter largely into the trade of countries which use silver. As to the future of silver prices, low prices will probably stimulate its use in the arts and may indeed suggest new outlets. Of a certainty they will reduce the output substantially, and have in fact already done so. If the various Governments who have been selling discontinue the practice, and if some Governments will use more silver and less paper and nickel in their subsidiary coinage, the

market will receive some help. If, on the other hand, there is a "flight from silver" in the East, which would not be strange when we study its treatment and history of late years, the decline may become more serious and its effects more widespread than even they are to-day.

Turning to lead—the metal in which we are most interested, notwithstanding the title of our corporation—the comparison of prices shown in our report does not make such a sorry showing as the movements of many other commodities, but the fall is sufficiently serious and doubly difficult to bear with the collapse in silver and spelter. Lead, which averaged nearly £23 5s. in 1929, is to-day about £5 per ton lower, and for the first six months of the year averaged £4 per ton below 1929. Every rise or fall of £1 means approximately £40,000 a year, plus or minus, to our gross revenue, but in considering the statement with our profits for the past year I must ask you to bear in mind that in the latter, as I have already explained to you, the price at which we took unrealized lead into our accounts for 1929 was very much less than £23 5s. per ton. We believe that as a result of the heavy decline in the price of lead itself, plus the serious collapse in zinc and silver values, production is being adjusted and that the statistical position to-day is much sounder than for some time past.

I now come to the spelter position. That it is bad and could hardly be worse is proved by the fact that to-day's price is over £8 or, say, 33% lower than the average for 1929, and £10 below the average of the first six months of last year. The world's production and consumption of zinc do not supply an adequate reason for the great collapse in prices. I am happy to say that after prolonged negotiations a base for a new world cartel has been found, and we are hopeful that it will be brought into successful operation at no distant date. I desire, however, to emphasize the absolute necessity for us and other producers of non-ferrous metals to rely not on higher metal prices for relief, but rather on higher efficiencies and definite economies in costs.

Fortunately for us, as a partial set off against the serious decline in the value of our products, we have in prospect some relatively substantial economies in cost and improvements in efficiency. We shall not be satisfied unless our total working costs fall by at least 5s. per ton of ore. All who are connected with our operations will understand that if our metals are to sell at cheaper prices they must be produced more cheaply—the only alternative being to close down. Such a situation demands the highest efficiency both above and below ground.

Before I close my address to you I must refer to two matters which are of major importance not only to our shareholders but to all British people. Firstly, there is the movement of commodity prices. These declines are not limited to non-ferrous metals. They form part of a marked decrease in commodity values throughout the world, assuming in some cases the character of a catastrophe and seriously disturbing the social as well as the financial and commercial structure of more than one important country. Whether this fall in commodity prices or increase in the value of gold arises from an insufficient supply of gold, rather than from an inefficient use of the available metal, I do not intend to discuss at this meeting. Whatever be the source of the trouble it constitutes a world-wide problem of supreme gravity. Certainly all debtor countries and all countries whose industry is in an important degree concerned with the production and distribution of basic commodities are suffering very severely. One thing which emerges clearly from the present situation is that there is an urgent demand for increased gold supplies. Herein lies a great opportunity for Australia to develop her gold-bearing properties.

This brings me to the general situation in Australia. The difficulties with which Australia is confronted arise primarily from:—(1) A serious decline in the value of her staple products, chiefly wool. (2) The severe effects of a drought (now happily over) on the volume of her production. (3) The effects of world-wide financial depression on the inflow of capital. There are other contributory factors it is true which have received considerable notice in Australia itself, but those I have mentioned are the salient reasons for a situation admittedly grave enough to cause considerable concern. A good idea of the extent of the blow which, without warning, struck Australia may be obtained from the official figures with regard to wool, which show that the drop in the value of the season's clip alone was from £25,000,000 to £30,000,000. Up to 1929 Australia had been receiving in new money from loans floated overseas between £25,000,000 and £30,000,000 annually, or approximately the amount of the annual charge on her revenue for her war obligations. Opinions vary with political beliefs as to Australia's policy of State ownership of public utilities, but the essential point is that very substantial external credits previously granted with readiness by a willing lender suddenly dried up in 1929. To these major factors there falls to be added the effect of the drought on the grain crops, all combining to intensify the burden of the war debt. Not only do I refuse to subscribe to the view that Australia's difficulties are to be attributed to any incompetence or improvidence peculiar to the Australian people, but I am confident that whatever the burdens—and they are obviously great—which may be imposed upon their backs in making necessary readjustments, they will be shouldered courageously and without undue delay. Our faith in Australia and her people is in no wise shaken by recent events.

It is possible my address to you may have sounded gloomy, and you may have gathered the impression that I consider the prospects for the future equally sombre. I do not. The world is passing through a period of severe economic adjustment, but the pendulum has already swung so far towards depression that it must soon commence to swing back. Recovery may not be long delayed. So far as this corporation is concerned, we have a great mine, well equipped, efficiently manned and managed, and linked with associated industries adding greatly to our strength. We are in a position to take the utmost advantage of returning prosperity.

I cannot conclude without expressing to our general managers, Messrs. Bewick, Moreing and Co., our staff and employees, our appreciation of their services to the corporation.

Mr. Wm. S. Robinson (managing director) seconded the resolution, which was unanimously adopted.

TANGANYIKA CONCESSIONS, LTD.

Directors: General Sir F. R. Wingate (*Chairman*), Sir C. L. Budd, F. Cattier, Earl Grey, T. P. Heyvaert, T. Honey, G. C. Hutchinson (*Assistant Managing Director*), S. Neave, The Marquess of Ormonde, C. F. Rowsell, Sir Robert Williams (*Managing Director*). *Manager and Secretary:* L. Scotland. *Office:* 95, Gresham Street, London, E.C. 2. *Formed* 1899. *Capital:* £5,500,000.

Business: Has a large holding in the Union Minière du Haut Katanga, and other mining and railway interests in Africa.

The annual general meeting of Tanganyika Concessions, Ltd. was held on July 31 at River Plate House, E.C., Sir Reginald Wingate (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year 1929, stated: M. Jean Jadot, at the recent meeting held in Brussels, said that, in spite of the great fluctuations in the copper market, it was nevertheless possible, on account of the careful policy adopted by the company in the past, to face the future with confidence.

Sir Robert Williams, Bt., in the course of his speech, said: The liquid assets amounted to £370,056, represented by cash and investments. The total shares and debentures in subsidiary and other companies amounted at cost to £7,410,552. In spite of the heavy fall in prices the value of your quoted shares and debentures at to-day's prices still shows a considerable margin over the book figure of the whole of your shares and debentures and the Benguela Railway Debt. The balance of the profit for the year is £473,154.

The whole of the plant, equipment, and accessory installations of the Union Minière du Haut Katanga, which can produce over 160,000 tons of copper per annum, besides valuable quantities of radium ore and cobalt alloy, stand in the books at a very low figure, equivalent to less than £4,000,000. The accumulated reserve funds, including the sums previously mentioned, amounted at December 31 last to the equivalent of nearly £1,500,000. Operations for the current year are very satisfactory. In spite of the present selling price being the lowest known for 30 years, the costs of production leave a very satisfactory margin of profit. The Union Minière can, by producing at full capacity from their high grade ores, particularly from the Western Mines and with the aid of the Benguela Railway, reduce costs to a very low figure.

The gross earnings of the Benguela Railway were equivalent to about £447,000, and exceeded the previous best by well over £100,000. Net earnings amounted to the equivalent of £194,000; the tonnage of goods was 275,381 tons. The construction of the Belgian section is proceeding very rapidly, and is being undertaken from both ends. This will complete the Lobito Bay Route, and provide through railway connexion across Africa.

The Kansanshi mine of the Rhodesia-Katanga Company is unlike any other mine in Northern Rhodesia, as it consists of vertical fissures passing through and impregnating with copper and gold various horizontal formations, and replacement bodies. Mr. Barnard, the engineer specially appointed to lay out and superintend the exploratory work, reports that there is a total of 8,000,000 tons of 4·15% ore in sight proved down to the bottom of the upper limestone in the three central blocks, from which 250,000 long tons of copper can be recovered. He adds that further underground development will progressively increase the above tonnage by length and depth extension, and the diamond drilling work done to date indicates that there will probably be a similar amount of ore to the same depth in the rest of the mine. The development so far, therefore, points to our having half a million tons of copper to a relatively shallow depth, à large part of which can be extracted by cheap open-cast mining. As the veins have been proved to extend below the upper limestone, and mineralization has been proved at 900ft., the maximum depth so far drilled, it may fairly be assumed that the figure of half a million tons of copper will possibly be doubled. With copper at anything like normal prices, we should make a profit of at least £20 per ton of copper on this grade of ore. In this connexion, it should be noted that below the 250ft. level the ores become sulphide, and their treatment cost will be correspondingly lower. Also, on an average throughout the whole mine, we can assume gold values of £2 per ton of copper.

Prospective work over the three areas in Uganda, totalling 14,380 square miles, has been continued. The Kilembe mine, in the Ruwenzori area, is proving a valuable property. It is estimated that 333,000 short tons of ore, of an average value of 4·5%, and containing 13,000 long tons of copper, are already practically proved. Judging from present indications and having regard to the locality itself, it is likely that Kilembe may be a big proposition.

Your company, with a total capital of £5,500,000, has provided £7,000,000 for Benguela railway construction and guarantee of debenture interest; acquired a very large interest in the Union Minière du Haut Katanga; built the Rhodesia-Katanga Junction Railway and bought out the Chartered company's interest in the Kansanshi mine; put £2,000,000 to reserve and paid over £2,000,000 in dividends, and has done this although your assets have not nearly reached maturity. The production of copper by Union Minière is little more than half what it will be. The Kansanshi mine has not started producing yet and what will probably be your greatest asset, the Benguela railway, is only now reaching its objective. Your company, like the Zambesia Exploring Company, was formed by Rhodes and myself to explore for mineral wealth to assist the Cape to Cairo Railway project, and, so far, that policy has been fully justified by results. Your company has opened up wealth in Rhodesia and Katanga which has led not only to the extension of the Cape to Cairo Railway but to the construction of about 3,000 miles of railway through British, Belgian and Portuguese territories. These discoveries have had a great civilizing influence in Central Africa, and have led to over £14,000,000 sterling being paid to the Rhodesian Railways, Wankie Colliery and British shipping lines, besides the provision of an immense amount of work for British, Belgian and Portuguese workmen. A large part of Central Africa has been opened to the world, as the result of that one effort.

The report and accounts were adopted.

JOHANNESBURG CONSOLIDATED INVESTMENT CO., LTD.

(Incorporated in the Union of South Africa.)

Mining Companies' Reports for Quarter Ended 30th June, 1930.

GENERAL REMARKS.—The development figures are the actual results of the sampling of development work on reef; no allowance has been made for modifications which may be necessary when computing the ore reserves.

10/11, Austin Friars, London, E.C. 2,

17th July, 1930.

Government Gold Mining Areas (Modderfontein) Consolidated, Ltd.

(Incorporated in the Union of South Africa.)

Issued Capital - - - £1,400,000.

Tons crushed, 602,000, yielding **273,826** fine ounces of gold.		Per ton, based on tonnage crushed.
Total Working Revenue	£1,163,141	£1 18 8
Total Working Costs	501,105	0 16 8
Working Profit	£662,036	£1 2 0
Sundry Revenue	21,135	
Total Profit for Quarter	**£683,171**	

No allowance has been made in the above for Government's share of profits or South African taxation. The expenditure on capital account amounted to **£2,704.** The DEVELOPMENT FOOTAGE sampled totalled **6,210** ft., and gave the following results:—**Payable 2,820** ft., having an average value of **15·7** dwts. over **43** in. of reef. **Unpayable 3,390** ft., having an average value of **4·1** dwts. over **33** in. of reef. A Dividend of **45%** (**2s. 3d.** per share) has been declared payable to all shareholders registered at 30th June, 1930. The Dividend will be payable on and after the 7th August.

Van Ryn Deep, Ltd.

(Incorporated in the Union of South Africa.)

Issued Capital - - - £1,196,892.

Tons crushed, 192,000, yielding **74,031** fine ounces of gold.		Per ton, based on tonnage crushed.
Total Working Revenue	£314,463	£1 12 9
Total Working Costs	199,715	1 0 10
Working Profit	£114,748	£0 11 11
Sundry Revenue	3,129	
Total Profit for Quarter	**£117,877**	

No allowance has been made in the above for South African taxation. The expenditure on capital account amounted to **£3,214.** The DEVELOPMENT FOOTAGE sampled totalled **3,475** ft., and gave the following results:—**Payable 1,465** ft., having an average value of **13·6** dwts. over **29** in. of reef. **Unpayable 2,010** ft., having an average value of **2·4** dwts. over **49** in. of reef. A Dividend of **15%** (**3s.** per share) has been declared payable to all shareholders registered at 30th June, 1930. The Dividend will be payable on and after the 7th August.

New State Areas, Ltd.

(Incorporated in the Union of South Africa.)

Issued Capital - - - £1,514,037.

6% Debentures - - - £279,900.

Tons crushed, 230,000, yielding **109,788** fine ounces of gold.		Per ton, based on tonnage crushed.
Total Working Revenue	£466,351	£2 0 7
Total Working Costs	247,725	1 1 7
Working Profit	£218,626	£0 19 0
Sundry Revenue	5,473	
Total Profit for Quarter	**£224,099**	

No allowance has been made in the above for Government's share of profits or South African taxation. The expenditure on capital account amounted to **£1,247,** and debenture interest to **£4,184.** The DEVELOPMENT FOOTAGE sampled totalled **4,530** ft., and gave the following results:—**Payable 3,140** ft., having an average value of **15·9** dwts. over **31** in. of reef. **Unpayable 1,390** ft., having an average value of **6·7** dwts. over **16** in. of reef. A Dividend of **7½%** (**1s. 6d.** per share) has been declared payable to all shareholders registered at 30th June, 1930. The Dividend will be payable on and after the 7th August.

The Langlaagte Estate and Gold Mining Co., Ltd.

(Incorporated in the Union of South Africa.)

Issued Capital - - - £1,519,833.

Tons crushed, 238,000, yielding **81,998** fine ounces of gold.		Per ton, based on tonnage crushed.
Total Working Revenue	£348,307	£1 9 3
Total Working Costs	254,214	1 1 4
Working Profit	£94,093	£0 7 11
Sundry Revenue	4,002	
Total Profit for Quarter	**£98,095**	

No allowance has been made in the above for South African taxation. The expenditure on capital account amounted to **£5,829.** The DEVELOPMENT FOOTAGE sampled totalled **5,940** ft., and gave the following results:—**Payable 3,490** ft., having an average value of **31·7** dwts. over **12** in. of reef. **Unpayable 2,450** ft., having an average value of **7·8** dwts. over **8** in. of reef. A Dividend of **10%** (**2s.** per share) has been declared payable to all shareholders registered at 30th June, 1930. The Dividend will be payable on and after the 7th August.

Witwatersrand Gold Mining Co., Ltd.

(Incorporated in the Union of South Africa.)

Issued Capital - - - £469,625.

Tons crushed, 164,000, yielding **36,940** fine ounces of gold.		Per ton, based on tonnage crushed.
Total Working Revenue	£156,912	£0 19 2
Total Working Costs	146,483	0 17 11
Working Profit	£10,429	0 1 3
Sundry Revenue	4,979	
Total Profit for Quarter	**£15,408**	

No allowance has been made in the above for South African taxation. The DEVELOPMENT FOOTAGE sampled totalled **3,010** ft., and gave the following results:—**Payable 1,030** ft., having an average value of **12·1** dwts. over **40·8** in. of reef. **Unpayable 1,980** ft., having an average value of **2·7** dwts. over **39·4** in. of reef. A Dividend of **5%** (**1s.** per share) has been declared payable to all shareholders registered at 30th June, 1930. The Dividend will be payable on and after the 7th August.

HENDERSON'S TRANSVAAL ESTATES, LTD.

Directors : Lord Stanley of Alderley (*Chairman*), J. M. Bailey, W. E. Lawson Johnston, H. G. Latilla, W. L. Castleden (*Managing Director*). *Secretary in South Africa :* V. Benjamin. *Office :* City House, Harrison Street, Johannesburg. *London Secretary :* F. R. Cunningham. *Office :* 36–38, New Broad Street, E.C.2. *Formed* 1912. *Capital issued :* £704,621 15s. in 5s. shares.

Business : Holds large interests in farming and mining properties in South Africa.

The eighteenth ordinary general meeting of Henderson's Transvaal Estates, Ltd., was held on July 18, 1930, at River Plate House, Finsbury Circus, London, E.C., the Rt. Hon. Lord Stanley of Alderley, (Chairman of the company), presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended March 31 last, said : Turning to the balance-sheet, the issued capital of the company is increased by £9 4s. 6d., all outstanding calls on shares having been paid up and fractions representing 32 shares presented during the year. Amount due to subsidiary company is a fresh item, the insertion of which is necessary under the new Companies Act. In comparing the two items in this year's accounts with the one item in last year's accounts, the result is an increase of £922 7s. 4d. " Farm sales suspense account " is decreased by £888.

" Reserve for depreciation in investments, etc.," is reduced from £114,345 to £100,000, the difference having been utilised in writing down the book values of various shares held by the company for many years.

Turning to the other side of the balance-sheet, " Subsidiary companies " is also a new item and was previously included in " Other stocks and shares." The reduction of £6,977 is mainly in respect of the £6,300 Delagoa Bay Development Corporation, Ltd. " Properties and plant, etc.," are reduced by £4,084 2s. 8d., £4,000 of which is a repayment by the by-products undertaking and the annual depreciation written off that asset. Investments in gilt-edged securities are increased by nearly £20,000, and at the close of the year stood at £135,172. " Other stocks and shares " are reduced by £9,626 charged to the " Reserve for depreciation " account. " Sundry debtors " show a reduction of £25,751. " Dividends and interest receivable " appear to show a reduction of £2,830, but this is not really the case, as last year under this heading was included an item of £2,740, while this year the corresponding item of revenue was in our coffers prior to March 31. Cash is increased by £19,028 and now stands at £95,241.

The balance of profit for the year carried to the balance-sheet is £39,071, making, with the amount brought forward from last year £45,749 to the credit of profit and loss. We have already paid you an interim dividend representing £17,605 9s., leaving an unappropriated balance of £28,143 13s. 10d. Out of this we recommend the payment of a final dividend at the rate of 2½% less income-tax, making a total of 5% for the year ended March 31 last. This will absorb approximately £17,606, leaving a balance of £10,537 to be carried forward to the current year. We also declare an interim dividend of 2½% in respect of the current year, both dividends to be paid simultaneously.

The demand for surface rights from the Henderson Consolidated Corporation showed an improvement as compared with the previous year and 13,815 acres were disposed of at satisfactory prices, minerals being reserved. The net revenue of the corporation for 1929 was £14,414. The dividend was 5% against 4% for 1928, and the carry-forward £27,932, against £28,938.

The very satisfactory results of the prospecting operations on the Havelock concession in Swaziland will be reflected in the accounts of the corporation for the current year, and as the bulk of the purchase price of the 100 claims has been paid in cash, this has placed the corporation in possession of an amount in excess of its requirements. The directors of the corporation have, therefore, resolved to reduce the capital of the corporation by 2s. 6d. per share, payable in cash. The whole of the sum of £38,552 represented by the 2s. 6d. per share will come to Henderson's Transvaal Estates, Ltd., and will be of assistance in financing the reduction of capital to which I shall be referring later. The preliminary arrangements for the examination of the balance of the concession have been made.

The increase in the rate of the dividend of Delagoa Bay Development Corporation, Ltd., is a matter for congratulation.

The rates of dividend paid by Tweefontein Colliery, Ltd., continue on the same satisfactory basis.

The results to September 30 last of Tweefontein United Collieries, Ltd., must be regarded as quite satisfactory. The output for the first eight months of the current financial year of the colliery company shows a falling off in tonnage of 27,882 tons, but in spite of this the profits are higher.

In spite of the continued intense competition for the South African market by foreign importers, Tweefontein By-Products has again been successful in keeping its plant working continuously throughout the year.

Our interest in Daggafontein Mines, Ltd., remains the same.

The dividends received by us from the South African Construction Company, Ltd., are at the same satisfactory rate as for the previous year.

It is with much satisfaction that your directors are able to put forward the resolution for the reduction of capital by 1s. per share. As we point out in the report, our cash and Government securities represent £230,000, and if you add to this the sum of £38,552, which we shall receive from the Henderson Consolidated Corporation, Ltd., you have a total of £268,552. Deducting from this the £140,924 involved in the return of capital, there will still be available £127,628, which, in the opinion of your directors, is sufficient for the purposes of the company.

Mr. W. L. Castleden seconded the resolution and it was carried nem. con.

A resolution was also carried approving the proposed return of capital.

TRONOH MINES, LTD.

Directors : C. V. Thomas (*Chairman*), W. J. Payne, Harry Rich, C. V. Stephens, J. H. Rich. *Secretary :* T. P. Patterson. *Office :* Portland House, 73, Basinghall Street, London, E.C. 2. *Formed* 1901. *Capital issued :* £299,361 15s. in 5s. shares.

Business : Operates alluvial tin property in the State of Perak, F.M.S.

The twenty-eighth annual general meeting of Tronoh Mines, Ltd., was held on July 16, 1930, at 73, Basinghall Street, E.C., Mr. C. V. Thomas (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year 1929, said : The total output of tin ore during 1929, including the ore produced by tributors, was 1,863 tons, which is 666 tons more than in the preceding year. Four dredges were in operation throughout the year. The dredges produced 1,324 tons of ore which realized £169,404, compared with 574 tons which realized £78,340 in 1928. The average price obtained was £128 per ton, as against £137 per ton in the previous year. Tributors' ore produced a profit of £10,720, which is £1,522 less than in 1928.

The amount brought forward from 1928, after deducting the capital bonus of £50,000, was £47,027. Adding thereto the profit for 1929 of £138,862, makes a total credit to profit and loss account of £185,888. Deducting the dividends paid—namely, 32½%—amounting to £93,368 and the amount written off property, plant and machinery, buildings and furniture, £35,668, there remains a balance of £56,852, which it is proposed to carry forward to the current year.

Since the close of the year, the Puket Tin Dredging Company has been registered, in which company we have one-third interest, and the Waihi Gold Mining Company the other two-thirds interest. This is considered a valuable property, and I agree with the opinion expressed by the Chairman of the Waihi Gold Mining Company, at its meeting in May last, when, referring to this Puket proposition, he added, "we are working on careful and conservative estimates and when our dredge is at work we believe we shall be able to make profits on prices of tin which would prove ruinous to many other companies."

Now, with respect to the all-important subject of tin restriction. Your Board have decided to adopt the two-months' stoppage advocated by the Tin Producers' Association. With respect to two companies in which Tronoh is largely interested—namely, the Sungei Besi Company, where, because of heavy and constant pumping charges, it would be unreasonable to expect a complete stoppage, that company has with the approval of the local committee of the T.P.A. adopted the 20% basis as from June 30 last, and a little company called Pari, in which the output is so very small that no restriction is considered necessary.

The resolution was carried unanimously.

SUNGEI BESI MINES, LTD.

Directors : C. V. Thomas (*Chairman*), W. J. Payne, Stanley Wickett, G. W. Simms. *Secretary :* T. P. Patterson. *Office :* Portland House, 73, Basinghall Street, London, E.C. 2. *Formed* 1909. *Capital issued :* £148,000 in 5s. shares.

Business : Operates alluvial tin property in the State of Selangor, F.M.S.

The nineteenth annual general meeting of the Sungei Besi Mines, Ltd., was held on July 16, 1930, at 73, Basinghall Street, E.C., Mr. C. V. Thomas (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year 1929, said : The output of tin ore during 1929 was 554 tons, or 15 tons more than in the preceding year. The yardage mined was 29,000 cu. yd. less than in 1928, owing to the fact that both karang inclines were lowered during the year. The average tin content of the ground treated was 4·9 katties, or 6·54 lb., per cubic yard, which is 1·02 lb. better than in 1928. After charging depreciation, the profit for the year is £17,411 12s. 7d.

Four dividends totalling 12½% were paid during the year, amounting to £18,500, leaving a balance of £30,597 to be carried forward.

All roads and drains at the new village site were some time since completed and handed over to Government. A large number of the building lots in this new village have been sold by the Government. When the sale of the remaining lots is completed substantial sums of money will be payable to this company, but it is not yet possible to specify the exact sum which will be received.

The new opencast in this area is being laid out for and equipped with electrically operated power shovels and it is anticipated that considerable working economies, as compared with the operations at the old mine, will thereby result. Development of this area has been well started and well laid out. The overburden has been dumped to form the site for the new treatment plant. It will take six to eight months to complete the equipment, but in the meantime the development work is being energetically pushed on so that the designed scale of operations may be attained as quickly as possible.

As I stated last year, if the contractors had carried out their obligations to time the anticipations of 1928 would have been realized and we should have been using hydro-electric power many months earlier.

The special attention of the shareholders is directed to the clause in the general manager's report relating to prospecting, from which it will be seen that he regards the Pelepah area therein mentioned as an excellent bucket-dredging proposition. That view is entirely shared by the Board The option was secured by this company and will now be exercised. The Board are not yet in a position to inform the shareholders as to the manner in which the capital required to work that area will be raised.

Mr. G. W. Simms seconded the resolution, which was carried unanimously.

BISICHI TIN COMPANY (NIGERIA), LTD.

Directors : William Graham (*Chairman*), J. Gardiner, W. S. Coutts, H. E. Nicholls, S. Fortescue, R. Sewell. *Consulting Engineers :* Foley, Boyes, Butler and Peek. *Secretary :* W. W. Evans. *Office :* 33, Cornhill, London, E.C. 3. *Formed* 1910. *Capital issued :* £460,000 in 10s. shares.

Business : Operates alluvial tin properties on the Bauchi Plateau, Northern Nigeria.

The ordinary general meeting of the Bisichi Tin Company (Nigeria), Ltd., was held on July 31 at Cannon-street Hotel, E.C. Mr. William Graham (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year 1929, said : Our proved reserves at December 31 last are stated at 11,285 tons, but, in addition to those proved reserves, there is undoubtedly a large quantity of unproved reserves. We are month by month and year by year recovering tin from parts of the property in respect of which no credit is taken for as reserves. Substantial depreciation has been written off our plant, in addition to the depreciation in respect of the dredge, and we are satisfied that an ample allowance has been made in that respect.

It is with satisfaction that I can once again point out how strong is our financial position. At the end of last year stock of tin and cash actually in the coffers of the company amounted to £103,852 7s. 3d., and to-day the position is somewhat better than that. These liquid resources are a great asset to this company, and our policy in keeping them in that state has been fully justified by the trend of events.

Reviewing the mining account, the expenditure on tin winning shows a substantial increase over the previous year. This, of course, is occasioned by the largely increased output, amounting to 581 tons over that of 1928.

Having regard to the fact that this company has earned a profit of £16,086 17s. 6d. during the last financial year after writing off depreciation, the directors have carefully considered whether a dividend should not be distributed. They have come to the conclusion that it is fair to the shareholders to pay a dividend of 5%, small though that may be for a mining company. We feel that the resources of the company, even in these serious times, justify such a distribution. I think it is a cause for some gratification that during such an unsatisfactory period as last year the company was able to earn a profit. It is very sad that we should have reached a period of large outputs, which is contemporaneous with the terrible slump in the price of tin.

You will probably expect me to say a word in regard to our policy towards the restriction of output. We have not gone the whole length of restriction that has been advocated by certain authoritative persons, but we have practised a policy of restriction. For the past three months we have curtailed our output to 65 tons per month, which is equivalent to a 20% reduction over the average for 1929. As, however, we are in a position to produce a good deal more than we did last year on the average per month, our contribution to the restriction policy has been a fair one. The Tin Producers' Association invite further cuts to the extent of either closing down completely for two months or, alternatively, by producing during the next three months only one-third of the production of the corresponding three months of last year. We have come to the conclusion that it would not be economically sound for us to agree to that suggestion. We realize the importance of conserving our reserves, and at the same time we also realize the advisability of not incurring losses. We have therefore decided as a further measure of restriction to curtail our output for the present to a tonnage that will cover all expenses. By this means our plant will be kept in running order and free from harm, our European staff will be maintained and all the labourers that can be usefully employed will be kept on, and we think we should limit our restriction of work to the amount I have stated.

In regard to the directors, Mr. Latilla retired from the Board last autumn, through ill-health. His companies, as you know, hold a considerable block of shares in this company, for which they paid a substantial premium. It was reasonable that they should have representation on the Board and, therefore, on Mr. Latilla's retirement, Mr. Sewell was appointed to take his place, and Mr. Sydney Fortescue was also appointed. The addition made to the Board was only made upon the terms that the company were not put to any additional expense, and the fees have been pooled in such a manner that the additional director does not cause the company any additional expense.

Reference has been made in the Press to rumours of absorption of this company. It is a fact that there have been negotiations, but such negotiations have not resulted in a bargain.

There is one matter I would like to touch upon before I sit down, and that is the suggestion that has been made by an important shareholder that instead of paying a dividend we should take steps to make a return to the shareholders of, say, 1s. a share. Such a course would involve the delay occasioned by an application to the Court to permit a reduction of capital, and could only proceed upon the footing that we have more liquid assets than are required for the company. One shilling a share would involve a depletion of our assets to the extent of £46,000, and the majority of the Board at all events formed the opinion that it would be unwise to such an extent to deplete our assets and that we should content ourselves with paying the modest dividend of 5% less tax. Cash in an industrial company to-day is of inestimable value. There are not so many concerns that are placed with a sufficiency of it, and our reserves should, in my opinion, render the shareholders a far larger pecuniary advantage in the future by assisting us to go through evil times and reap the profit of good times than the receipt by shareholders of a sum of 1s. a share now. I daresay views different to those held by me may be held by other people. It is quite reasonable for another view to be taken, but I personally am strongly of opinion we should adopt the policy recommended to you in the report.

Mr. W. S. Coutts seconded the resolution, which was carried unanimously.

GREAT BOULDER PROPRIETARY GOLD MINES, LTD.

Directors: John Waddington (*Chairman*), Sir Newton J. Moore, A. H. Collier, R. Hamilton (*Local Director in Australia*). *General Manager:* John Warwick. *Secretaries:* A. J. Culley, H. T. Skipp. *Office:* 341, Salisbury House, London Wall, E.C. 2. *Formed* 1894. *Capital:* £175,000 in 2s. shares.

Business: Operates gold-mining properties in the East Coolgardie district, Western Australia.

The thirty-sixth annual general meeting of the Great Boulder Proprietary Gold Mines, Ltd., was held on July 22, 1930, at River Plate House, E.C., the Hon. Sir Newton J. Moore presiding.

Sir Newton Moore, in moving the adoption of the report and accounts for the year 1929, said that after allowing for the amount transferred to finance and exploration account and the expense of re-numbering the shares, the year's working on a strict comparison with 1928 showed a profit of some £17,500, against £23,432 for 1928. As a result of development work during the year under review, 84,592 tons of ore had been added to the reserves, which meant that, after allowing for 85,342 tons treated for the year, the reserves at December 31, 1929, stood at 80,372 tons, which was only some 750 tons less than at December 31, 1928, while the values had increased from 9 1 dwt. to 9·7 dwt.

Shareholders were doubtless aware of the renewed agitation which was taking place in Western Australia and the other States in favour of a gold bonus. At a recent mass public meeting in Perth a resolution had been unanimously adopted supporting the payment by the Federal Government of a bonus of £1 per ounce on new standard gold produced in Australia during the ensuing 10 years, and urging upon the Government to give favourable consideration to its adoption at the earliest possible moment as a means for speedily relieving unemployment throughout the Commonwealth and restoring the parity of the Australian £1 abroad. Both the Premier and the Leader of the Opposition had given their unqualified support in telegrams to the Chairman of the meeting, the Lord Mayor of Perth. Mr. Keenan, the Chief Secretary, stated that there was no room for divided opinion, and there was no necessity for delay in the application of the proposal.

He (the Chairman) need hardly point out that any bonus granted would materially affect the future of the Great Boulder, which had produced a total of approximately 14½ millions worth of gold and had distributed over £6,000,000 in dividends and which, provided some slight assistance was afforded, would continue for years to come to produce at a profit gold which, under existing circumstances, would remain in the ground instead of affording employment to thousands of miners and contributing materially to the wealth of Australia and the Empire. The Board, in common with other gold mining companies, were giving the present campaign their strongest support.

The resolution was unanimously adopted.

THE SUB NIGEL, LIMITED.

(*Registered in the Union of South Africa.*)

NOTICE TO SHAREHOLDERS.

NOTICE IS HEREBY GIVEN that the Thirty-second Ordinary General Meeting of Shareholders in the above Company will be held in the Board Room, Consolidated Gold Fields Buildings, Simmonds Street, Johannesburg, on Thursday, the 20th November, 1930, at 11.30 a.m., for the following purposes, viz.:—

To receive and consider the Balance Sheet and Accounts for the year ended 30th June, 1930, and the Reports of the Directors and Auditors; to elect Directors and Auditors and to transact such other business as may be transacted at an Ordinary General Meeting.

The Transfer Books of the Company will be closed from the 6th to 20th November, 1930, both days inclusive.

By Order,
A. J. PARKIN, *London Secretary.*

LONDON OFFICE: 49, MOORGATE, E.C. 2.
16th July, 1930.