The Mining Magazine

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EDITORIAL

THE appointment of Mr. J. A. Agnew as chairman of the Consolidated Gold Fields of South Africa is of interest, as it places at the head of this important undertaking one who has spent many years on the practical side of mining.

LAST month the 1933 edition of Skinner's "Mining Year Book"—the forty-seventh annual issue—was published. This work contains particulars of the world's principal mining companies and as more foreign undertakings are added each year its international character continues to grow, a fact which adds to its value for all associated with the industry.

THE University of Sheffield last month issued a booklet containing particulars of research work carried out in the departments of mining and fuel technology during the 1931–32 session. The efforts of the school are almost entirely connected with coal mining, the booklet describing in non-technical language the work that has been already reported in the technical press.

A COMMITTEE has recently been appointed by the Mines Department to inquire into the precautions which may be taken to prevent overwinding. The chairman is Mr. F. H. Wynne, Deputy Chief Inspector of Mines, and the members Messrs. J. M. Gillians, B. J. Marson, H. M. Morgans, J. A. S. Ritson, and R. Shirkie, Mr. J. E. Henshaw being secretary.

CHANGES in the direction of the Camborne School of Mines are shortly to be effected. Mr. C. V. Thomas has resigned his position as chairman of the Governors and is to be succeeded by Mr. Harry Rich, Mr. Thomas remaining on the committee of the school. In addition Mr. R. A. Thomas and Mr. T. Knowles are to retire, although the latter will continue to act as secretary to the Governors. The appointment of the new principal is awaited with interest.

A SECTIONAL meeting of the World Power Conference is to be held in Stockholm between June 26 and July 10 next, when delegates will discuss the energy problems of large-scale industry and transport. A number of visits and excursions in Sweden, Denmark, Norway, and Finland have been arranged for those attending the conference, which, it is felt, will afford a unique opportunity for the industrialist and the power engineer to come into contact.

TWO nominations are announced by the American Institute of Mining and Metallurgical Engineers—that of Dr. Frederick M. Becket as president for the ensuing year and that of Mr. James O. Elton as James Douglas medallist. Dr. Becket's election is noteworthy in that he is a Canadian and a graduate of McGill University. He has been intimately associated with the advance of electro-metallurgy, having been connected since 1903 with the Niagara Research Laboratories and its successor companies.

SPEAKING recently in Camborne, Mr. C. V. Thomas intimated that the receiver at present in charge of the Dolcoath mine, appointed by the Government, was likely to be withdrawn and the machinery dismantled. Mr. Thomas felt that such a step was much to be deprecated, as, if the receiver were permitted to remain until tin prices improved, something might be done to restart this famous old mine. This is an opinion with which one can hardly fail to agree, in view of the deplorable unemployment situation in the county.

THE British Industries Fair continues to grow, although this year witnessed a further falling off in the support accorded it by the heavy industries. Regrettable though this abstention may be, since it detracts somewhat from the representative character of the Fair, it is hardly surprising in view of the considerable expense incurred in the transport of heavy plant, apart from the cost of running it. As was pointed out last year, the tendency among such industries is to reserve their expenditure for the specialized exhibitions generally held in London in the autumn. Nevertheless, as is evident from the details published elsewhere in this issue, there was even this year plenty at Birmingham to interest the mining man.

ELSEWHERE in this issue is a letter from Mr. Foster Bain, commenting on the article on the American Debt which appeared in our January issue. It will be seen that the letter is not only more lengthy but much more controversial than our editorial and the many points Mr. Foster Bain raises will doubtless be dealt with by those concerned in carrying through the forthcoming negotiations. As in the January issue we clearly expressed our view, it is now only fair to give the other side, and it will readily be conceded that in this respect we have erred on the generous side. In view of the banking crisis in the United States, however, it is interesting to note the recently-published statement of the Swedish economist, Professor Gustav Cassel, to the effect that "When the United States in December insisted on the payment of war debts this proved a final blow to American economic life."

The Institution Meeting

At the February meeting of the Institution of Mining and Metallurgy two papers of widely different character were presented for discussion—one by Messrs. V. T. Edquist, C. Valentine, and Norman Dunstan on the use of gas power at the Sons of Gwalia mine, Western Australia, and the other by Mr. C. B. E. Douglas entitled "Native Wire Silver: Notes on its Formation and Possible Significance." The first paper was introduced by Mr. W. A. Macleod, of Messrs. Bewick, Moreing, and Co., the general managers of the Sons of Gwalia mine, who, it will be recalled, was himself the author of a paper read before the Institution in December, 1926, on the subject of internal combustion engine power for mines, in which reference was made to this plant, a précis of this part of the paper being published in the MAGAZINE at the time. The second paper was introduced by Sir Harold Carpenter. Both contributions were full of interest and the ensuing discussions fully occupied the time available.

In introducing the first paper Mr. Macleod drew attention to the manner in which the work described had developed, pointing out that there was a marked trend towards the simplification of equipment, the power used at the present time being economically produced with little or no trouble. The Sons of Gwalia mine is situated near Mount Leonora, in the North Coolgardie goldfield, and gas power was first used there in 1911, the original plant being added to in 1912. The first unit of this original plant used an up-draught suction-gas producer, with mulga charcoal as fuel, while the second unit was operated by a down-draught wood producer. In 1921 the plant and power house were destroyed by fire and in the course of the reorganization which followed this disaster it was decided to operate all but the winding plant electrically and to replace the steam-driven air-compressors by gas-driven units. This change necessitated the installation of engines giving continuous service under trying conditions, the temperature of the engine-room in summer frequently rising to over 135° F., and those installed, of the Crossley-Premier horizontal type, have proved eminently suitable for the conditions obtaining in such an isolated situation. As regards the producers themselves, the tendency has been to develop the down-draught type and those at present in use at the mine are the outcome of research by many workers, among whom mention should be made of Mr. W. R. Degenhardt and the late Messrs. Jordan and Beech, as well as the authors of the present paper. It has to be remembered that conditions at the property rendered the adoption of gas power necessary, in view of the scarcity of fresh water and fuel supplies. The wood fuel available is being drawn from the bush at a distance of 40 miles from the mine and is delivered by rail at a cost of 18s. per ton. For actual details of the plant the reader is referred to the paper itself, which forms a valuable supplement to that by Mr. Macleod, and much new practical information has been made available by its publication. The costs are particularly instructive and the figures for the 500 h.p. No. 1 Premier gas-electric set, covering the years 1926 to 1931, show that the running time was 50,020·6 hours, or 95·12% of the full time possible, the output being 13,289,460 units for an average consumption of 3·91 lb. moist fuel per unit and an average cost of 0·714d. per unit. More recent practice has improved even on these figures, the output of the combined gas-electric sets during the month of July, 1932, being obtained at a running cost of 0·68d. per unit. Yet one more item deserves mention, that of waste-heat recovery. The first recuperators installed came from Germany, but the last was made in Australia, the satisfactory performance of the equip-

ment being reflected in the authors' statement that the estimated saving in fuel cost for the steam winding plant resultant on their installation has in less than three years been equal to the capital cost of the plant. Discussion of the paper was initiated by Mr. Degenhardt, who referred to the keenness with which research on the use of gas power had been prosecuted in Western Australia and went on to review early difficulties, concluding with a comparison between the cost of wood and oil fuels at the mine. Messrs. A. K. Bruce and W. A. Tookey—names well known in the world of mechanical engineering—and Messrs. H. Morgans, S. H. de la Mare, L. A. Skinner, T. J. Taplin, and the president, Dr. Sydney Smith, also took part in the discussion. The general interest aroused by the paper seemed to show that there was some truth in Mr. Macleod's contention that the time was ripe for another general discussion on power generation.

While the first paper would appeal to the mechanically minded, the second was of interest more particularly to metallurgists and geologists. The author states that he has not been convinced by the widely-held opinion that all native silver was deposited from solution and he had set out to endeavour to produce it by other means. With this end in view he had buttons of silver sulphide made with which to experiment, the buttons being prepared by melting freshly-precipitated silver sulphide in glazed crucibles in an electric furnace, the surface of the buttons being protected by a charcoal cover. Under these conditions it was found that some metallic silver had separated and further work at lower temperatures confirmed this, metal of the "wire" form growing in each case. The author was thus able to show that metallic silver can grow on the sulphide at low temperatures under oxidizing conditions and he draws the obvious inference that there is no reason why the native metal should not have been formed from argentite at temperatures not much above normal in the course of geological time. The importance of the results of these simple experiments was mentioned by Sir Harold Carpenter in his introduction and although, as Dr. Fisher ultimately pointed out, the results are not strictly new the low temperatures at which the reaction can take place have been sharply brought to the notice of research workers. The author, modestly enough, suggests that the work may be worthy of further investigation by others better equipped to carry it out and one was able to gather from the introductory remarks that his suggestion is not likely to remain unheeded.

Research and Industry

In reviewing the report of the advisory council of the Department of Scientific and Industrial Research last year it was pointed out that the work of this department is of considerable importance to the mining man, for, if research on production methods is a necessity for the primary commodity, it is equally important that the utilization of the commodity should be actively investigated. For this reason, although so much of the routine of the department is concerned with the uses to which the raw materials of production can be put, its activities may be considered worthy of review. The new report,[1] covering the year 1931–32, contains an admirable summary of the progress of industrial research in this country and the gradual awakening of the scientific mind to industrial realities is as well illustrated as is the tardiness with which industry utilizes new materials placed at its disposal. It is to be observed that in nearly every industry to-day movements are on foot to find new uses for old materials and mining men will be well aware, for example, that such an organization has been formed under the auspices of the Tin Producers' Association to undertake research and to conduct propaganda and development work for extending the uses of that metal. Clearly, therefore, it is recognized that industry is best able to help itself in this direction, for the attention of the Department should be directed towards finding suitable uses for new products. Industry often seems slow to realize, however, that science has many practical results waiting to be applied and there is an appreciable lag here which may well be speeded up. It is possible that if more business concerns could be induced to give financial support to the work that is being done with the particular products in which they are interested a step would have been taken towards lessening the time gap between discovery and industrial application. It is interesting to note, therefore, that the advisory council to the Department has given some consideration to a suggestion

[1] Report of the Department of Scientific and Industrial Research, 1931–32. H.M. Stationery Office. Price 3s.

that Research Associations should be placed in a stable financial position by means of an Enabling Bill passed by Parliament, which would give authority to raise funds from industry for purposes of industrial research. Inquiry in this direction, however, served clearly to indicate that the general trend of opinion was that if industries could not be persuaded to support research little was to be gained by forcing them to do so. It is worth observing that it was generally feared that statutory action of this nature would mean a loss of liberty of action by the various members of the research organizations and that in this manner personal enthusiasm, such an important asset in the development of new activity, might begin to wane. It is probably true that live members of a research organization would be the first to profit by a new discovery, but they have paid for it by their contributions and it seems unfair that others, standing outside the organization's activities, should be able to make use of its published results. The matter is at present left in abeyance, but it is felt that something must be done by voluntary effort to place the finances of particular organizations on a sound footing or compulsory levies may be necessary.

The report notes that in no branch of the Department's activities was the depression so seriously felt as at the National Physical Laboratory, where the fall in receipts from testing fees and for special investigations made it especially difficult to maintain a trained staff which would be in readiness for a return to better times. The work of the Laboratory's metallurgical department is mainly concerned with the physical structure of metals and alloys and with their properties under a set of specified conditions. Passing on to the activities of the Fuel Research Board, one of its most important tasks has been the continuation of the physical and chemical survey of the national coal resources, while important work in connexion with low-temperature carbonization has been actively carried on, the horizontal retorts at the Fuel Research Station having been rebuilt and set to work and two new brick retorts erected and tried out. The good results achieved by these new retorts were recently described in a Technical Paper [1] and it is believed that considerable progress is being made towards solving some of the outstanding problems of low-temperature carbonization. This new retort is cheap in capital cost, is easy to work, and gives good results with small labour requirements, without producing unpleasant fume. As regards the hydrogenation of tar, the study of the most suitable and economic catalysts has been continued, both static converters and small continuous plants being used for the purpose, while it is intended to proceed with the erection of a plant capable of dealing with one ton of tar per day. The use of the "Elmore" flotation plant for experiments in the cleaning of coal is said to have given very promising results and the effects of "weathering" are being investigated. The work of the Geological Survey of Great Britain in regard to geophysical investigations has been suspended, the Survey's apparatus having been handed on loan to the Professor of Geophysics at the Imperial College, where researches on this subject are being continued as part of the activities of the new School of Applied Geophysics. In this connexion it is interesting to note that the results obtained by Professor A. H. Cox and Mr. S. W. Rice, of Cardiff, on the use of electrical methods of survey for detecting approach to water-logged areas in coal mining have been of a negative character. Work carried out at various places for the Metallurgy Research Board has included investigations into the behaviour of metals at high temperatures, into the properties of light alloys and of the minor metals, into the casting of ordinary and alloy steels, and into the cracking of boiler plates. Electro-deposition is being investigated at Woolwich and Farnborough, while the British Non-Ferrous Metals Research Association has continued its successful programme.

Although the results achieved by intensive research of this character may sometimes seem small, it should be remembered that they often have far-reaching results. In this connexion it may be recalled that the presence of a trace of silver in the copper used for boiler tubes has meant an immense improvement in their performance. The main feeling in reviewing the activities of this Government department is one of satisfaction that such machinery exists as will take care of the development of industrial uses for the metals the miner produces.

[1] "Low-Temperature Carbonization: Narrow Brick Retorts at the Fuel Research Station." Fuel Research Technical Paper No. 35. H.M. Stationery Office.

REVIEW OF MINING

Introduction.—The major event of the past month has been the banking crisis in America, which has temporarily affected business. Although the United States has for a short period been virtually driven off the gold standard, there seems no reason why this should last for any length of time, especially as such energetic measures have been taken by those in control. In the base-metal industry the outlook for zinc has been improved by the agreement reached between producers to prolong the existing cartel until July 1 next, while copper seems so far to have been but little affected by the cessation of agreed restriction at the end of 1932. The notice of an extra 2% cut in the April–June tin production of the F.M.S. appears to have acted favourably on the price of that metal.

Transvaal.—The output of gold on the Rand for February was 835,931 oz. and in outside districts 47,214 oz., making a total of 883,145 oz., as compared with 967,457 oz. in January. The number of natives employed in the gold mines at the end of February totalled 222,589, as compared with 222,005 at the end of January.

The report of Crown Mines, Ltd., for 1932 shows a profit of £1,192,623, making, together with the balance brought in and sundry items, an available total of £1,652424. Of, this amount, £730,873 was distributed as dividends, equal to 77½%, while after making various allowances there was a balance of £503,493 to be carried forward. The ore milled totalled 3,332,000 tons, yielding 1,042,063 oz. of gold worth £4,419,903, osmiridium and silver recovered bringing the total revenue to £4,427,983. The total ore reserves at the end of the year were estimated to be 13,742,950 tons, averaging 6·64 dwt. in value, as compared with 12,997,390 tons, averaging 6·5 dwt., at the end of the previous year. Shareholders of the company have been informed that the Government has accepted their application for a lease of the undermining rights of an area equal to approximately 829 claims adjoining the company's southern boundary.

The Anglo American Corporation has been granted the right to prospect over the town lands of Potchefstroom and to purchase mineral rights for £12 10s. per morgen, the extent of such options to be not less than 5,000 morgen. Meanwhile rich developments have been reported by the West Springs company below the 2 S.E. haulage. Driving west from a new incline has exposed reef going 38·15 dwt. over 39 in., while to the east the ore has been struck by bore-hole 30 ft. below the drive and is found to assay 14 dwt. over 50 in.

Shareholders of Witpoort Gold Areas (in liquidation) have been informed that the whole of the purchase money due from Brakpan Mines, Ltd., has been received and that a first and final dividend is to be made to shareholders registered on February 28.

West Rand Consolidated Mines, Ltd., has announced that it is proposed to increase the capacity of the plant to 120,000 tons per month and that the necessary additions should be completed before the end of the current year.

In publishing the ore-reserve estimate for the end of 1932 the directors of the Witwatersrand Deep announce that the life of the mine for income-tax purposes has been determined by the Government mining engineers at six years from January 1 last, no allowance being made in this estimate for ore that may be added to the reserves consequent on the departure of the Union from the gold standard. The available ore reserves at December 31 last were estimated to be 596,000 tons, averaging 6·2 dwt. in value over a stoping width of 51 in.

In the last issue of the MAGAZINE the decision of the directors of the Sub Nigel to increase the capacity of the reduction plant to approximately 41,000 tons a month was announced and it is now known that a new issue of capital is contemplated. In addition to the installation of additional equipment, a new shaft is projected in the northern section of the property, which it is expected will go down about 5,000 ft.

Vogelstruisbult Gold Mining Areas, in which the Gold Fields, Rand Mines, and Anglo American groups are interested, has now been registered in South Africa with a capital of £507,500. The new company is to acquire and exploit a large mining area on the Far East Rand.

It is stated that the H.E. Proprietary has secured an option over a large area in the West Witwatersrand, close to that recently acquired by the Gold Fields Company. It is expected that the completion of negotiations will eventuate in the flotation of a company capitalized at £500,000 to undertake the development of the area.

Diamonds.—The report of the Premier (Transvaal) Diamond Mining Co., Ltd., for the year to October 31 last shows a loss of £60,554, which has been met from the balance in hand of the trading fund, which now amounts to £149,205, the deficit including a loss of £37,666 on exchange. Diamond sales totalled £83,587, as against £278,403 for the previous year. Operations at the company's mines were closed down on March 31 last, but the yield of the ground treated during the period worked was 22 carats per hundred loads, the highest average obtained for some time.

Southern Rhodesia.—The output of gold from Southern Rhodesia during January was 48,656 oz., as compared with 52,096 oz. for the previous month and 42,706 oz. in January, 1932. Other outputs for January were: Silver, 8,342 oz.; coal, 31,520 tons; chrome ore, 2,006 tons; asbestos, 2,675 tons; mica, 1 ton; tin, 1 ton; iron pyrites, 657 tons.

The report of the Wanderer Consolidated for the three months to December 31 last shows that work in connexion with the sinking of the Wanderer incline shaft was commenced and good progress made with the preliminary excavations, while actual sinking and rising is in hand between the 5th and 8th levels. Developments in the Ashton section are said to have given satisfactory results, good values over a large area having been disclosed on the 6th level.

Shareholders of the Cam and Motor Gold Mining Co. (1919), Ltd., were informed last month that the reduction of capital decided upon in January last had been sanctioned by the Court and that payment would be made during the present month.

The directors of the British South Africa Company have decided not to recommend the payment of a dividend at the meeting to be held this month.

Northern Rhodesia.—The report of Roan Antelope Copper Mines, Ltd., for the three months to December 31 last shows that 406,000 short dry tons of ore, averaging 3·68% total copper, was mined and milled, 9,398·91 long tons of blister copper being produced. The average total costs for the quarter were estimated to be equal to £22 8s. 2d. per long ton, before allowing for debenture interest and depreciation. Single-stage grinding has been successfully developed and this is said to result in a substantial reduction in power consumption, as well as increasing the capacity of the mill.

A circular to shareholders of Luiri Gold Areas last month stated that as the additional funds necessary for development had not been secured it was proposed to create a series of debentures for £40,000 to provide the working capital required.

Shareholders of the North Charterland Exploration Company have been informed that the public inquiry into the company's title is to be reopened, in order that further evidence and information may be laid before the Commissioner.

Gold Coast.—At an extraordinary meeting of the Atta Gold Company held this month it was approved that the capital of the company should be increased to £100,000 by the creation of 600,000 additional 2s. shares. The company has agreed to purchase the Besiasi concession, in the Kwahu district, the purchase price of £30,000 being taken in shares, while 100,000 new shares are offered to the existing shareholders at par.

Resolutions proposing that the capital of the Central Wassau Gold Mines, Ltd., should be increased by £50,000 to £150,000 in 2s. shares were approved at an extraordinary meeting held this month. The company, which until recently held a one-fourth interest in the Beposo property on the Ashanti belt, has now acquired a further one-fourth interest, the vendors accepting fully-paid 2s. shares in settlement of the purchase price of £20,000.

Belgian Congo.—It has been announced that from April 1 next the Union Minière du Haut Katanga will increase its production of copper from 40,000 to 56,000 tons per annum.

Uganda.—A progress report issued by Kagera (Uganda) Tinfields, Ltd., states that the 1932 output totalled 308 tons of concentrates, production costs showing a substantial improvement over those of previous years. The capacity of the existing plant is to be extended, while arrangements have been made to resume exploratory work at Namherere.

Kenya.—The output of gold from Kenya during 1932 was estimated to be 10,731 oz., of which 6,221 oz. was produced on the Kakamega field.

Australia.—The report of the Broken Hill Proprietary Company for the four weeks to February 19 last states that good progress has been made with the erection of a small treatment plant at the Hannans North mine, Kalgoorlie, purchased last

year. Other gold-mining activities of the company are reflected in the news that they are drilling the Enterprise Group Leases, Kalgoorlie, and hold options over alluvial properties near Wellington and Bingara, New South Wales.

Shareholders of Lake View and Star, Ltd., were informed last month that the New Consolidated Gold Fields had exercised its option over 100,000 Lake View shares of 4s. each at 10s. per share. The Lake View has recently declared a second interim dividend of 6d. per share.

Advice from the Great Boulder Proprietary Gold Mines states that the ore reserves at December 31 last were estimated to be 204,792 tons, containing 81,792 oz. of gold, in addition to 333,208 tons of probable ore. The reserves in sight at the end of the previous year were estimated to be 132,139 tons, containing 53,694 oz.

An important company has been registered in Melbourne under the title of the Western Mining Corporation, with a capital of £500,000. The chairman of the new company is Mr. Colin Fraser and it has been formed to carry on mining business throughout Australia. The members of the Westralian advisory committee are Messrs. H. E. Vail, Richard Hamilton, and J. W. Sutherland.

New Guinea.—The discovery of new dredging areas by New Guinea Goldfields was announced in these columns last month. Arrangements have now been made to send out a well-known engineer to estimate their value and to advise on plans for their working.

India.—It was announced last month that some exceptionally wide patches of ore had been encountered while stoping in the Oriental section of the Nundydroog mine. This company has just declared a dividend of 4s. per share, making a total distribution of 6s. per share, equal to 60%, as compared with 2s. 9d. per share in the previous year. The breakdown of an underground winding engine on the Ooregum mine last month was expected to interfere seriously with the monthly output.

Burma.—The Anglo-Burma Tin Company announced last month that it had purchased at par £6,150 of its debentures, which have been cancelled.

Malaya.—An advance report of Petaling Tin for the year to October 31 last shows a profit of £50,635, which, with £26,679 brought in, gave an available total of £77,314. Of this £46,667 has been distributed as dividends, equal to 20%, leaving £30,647 to be carried forward.

An issue of £400,000 4% prior lien debenture stock has been placed privately by the Perak River Hydro-Electric Power Co., in accordance with a scheme of arrangement which the company entered into with its debenture holders in January, 1931.

Canada.—A special general meeting of the International Nickel Company of Canada is to be held to confirm the reduction of the share capital by cancelling 167 shares of preferred stock and 14,454 shares of common stock surrendered for cancellation since December, 1929. The authorized capital stock is to be increased by the amount of the reduction.

Sweden.—The report of the Boliden Mining Company for 1932 states that after writing off kr. 3,318,000 the accounts show a profit of kr. 8,134,000, as compared with kr. 549,000 in the previous year, a first dividend equal to 10% being proposed. During the year 220,000 tons of ore was mined and sent to the mill, which has now been enlarged in order to handle 350,000 to 400,000 tons annually.

Cornwall.—The reduction of the capital of Geevor Tin Mines, Ltd., from £180,000 to £97,878, by cancelling capital lost, has now been sanctioned by the High Court.

British Tin Investment Corporation.—The accounts of the British Tin Investment Corporation for the eight and a half months from its incorporation to December 31 last show a profit of £11,726. After allowing £5,465 for income tax and £5,930 for preliminary expenses, there remained £331 to be carried forward.

Corderoy Mines.—The report of Corderoy Mines, Ltd., for the period to December 31 last shows that arrangements have now been concluded for the cancellation of the existing debentures, while at an extraordinary meeting held last month it was agreed that the existing "B" shares should be subdivided into five shares of 4s. each, ranking in all respects with the existing 4s. shares. These arrangements will enable the company to proceed with negotiations for what is stated to be a promising property.

Exploration Company.—The accounts of the Exploration Company for 1932 show a realized loss of £1,742. The company's interests in subsidiary companies and other investments had a market value of £123,359 at the end of the year, against a book value of £326,627.

THE TIN-TUNGSTEN DEPOSITS OF STEWART ISLAND, NEW ZEALAND

By GORDON WILLIAMS, B.E., M.Sc., D.I.C.

The author describes the mode of occurrence of the wolframite and cassiterite found on this island off the south coast of New Zealand.

INTRODUCTION.—The only part of New Zealand where cassiterite and wolframite can be regarded as being more than mineralogical curiosities is Stewart Island, lying off the southern coast. Stewart Island consists of a series of rugged granite peaks rising to 3,200 ft. and separated by tortuous drowned valleys, which form sheltered bases for the fishing fleets that work in the surrounding seas and for a Norwegian whaling company operating in the Antarctic. A heavy rainfall encourages a dense forest growth and only on the summits of the highest hills does the thick bush give way to an impenetrable wind-swept interlocking scrub and to peat and tussock, whilst in places areas of bare rock appear. The "prevailing westerlies" sweep across the bleak highlands, which are constantly buried in cloud.

The mineral deposits lie among the hills behind Port Pegasus, a tiny fishing base at the extreme south of the island. The deposits are in the form of lodes containing wolframite and cassiterite and placers containing these minerals and also gold. The deposits have been known for many years and unsuccessful attempts were made to work them towards the end of last century, but the field has since been neglected, except for a brief period in 1913. The district was visited by Alexander McKay, of the New Zealand Geological Survey, in 1888, but the present writer's work is the first attempt to map the deposits and to describe the mineralogical relationships and genetic processes.

SUMMARY OF GEOLOGY.—Stewart Island is a remnant of an extensive granite mass lying in the extreme south of New Zealand. The granite batholith has been deroofed by erosion and the extreme tips of the pendants of the invaded metamorphic rocks that lay deepest in the batholith now remain only on the tops of the highest hills. In the mineralized region the invaded rock is a biotite-schist and it is in an inlier of this rock, capping the Tin Range behind Port Pegasus, that the wolframite-cassiterite lodes appear. The streams that rise in the Tin Range and cross granite country on their way to the coast contain concentrations of minerals derived from the lodes and also the heavy accessory minerals of the granite they traverse.

METALLIFEROUS LODES. — Quartz veins appear throughout the remnants of biotite-schist that cap the higher hills behind Port Pegasus, but only those running along the sharp eastern crest of the Tin Range are metalliferous. The useful mineral is wolframite, but small amounts of cassiterite also occur. The metalliferous minerals are restricted to the actual veins—they are entirely absent from the country-rock.

Structure.—The metalliferous veins occur in a zone varying in width from a few yards to several chains. The useful minerals first appear about half a mile south of Trig. J and from this point the veins may be followed southwards for two miles as a series of disconnected outcrops to the extreme southern end of the Tin Range, where the lode-zone

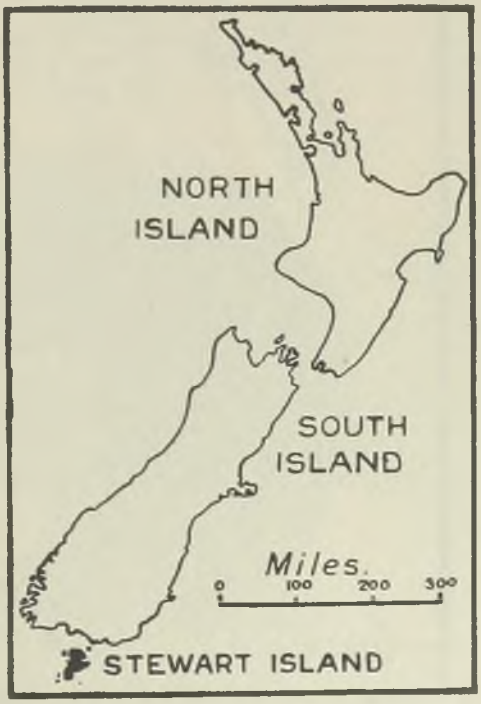

FIG. 1.—SKETCH MAP OF NEW ZEALAND SHOWING POSITION OF STEWART ISLAND.

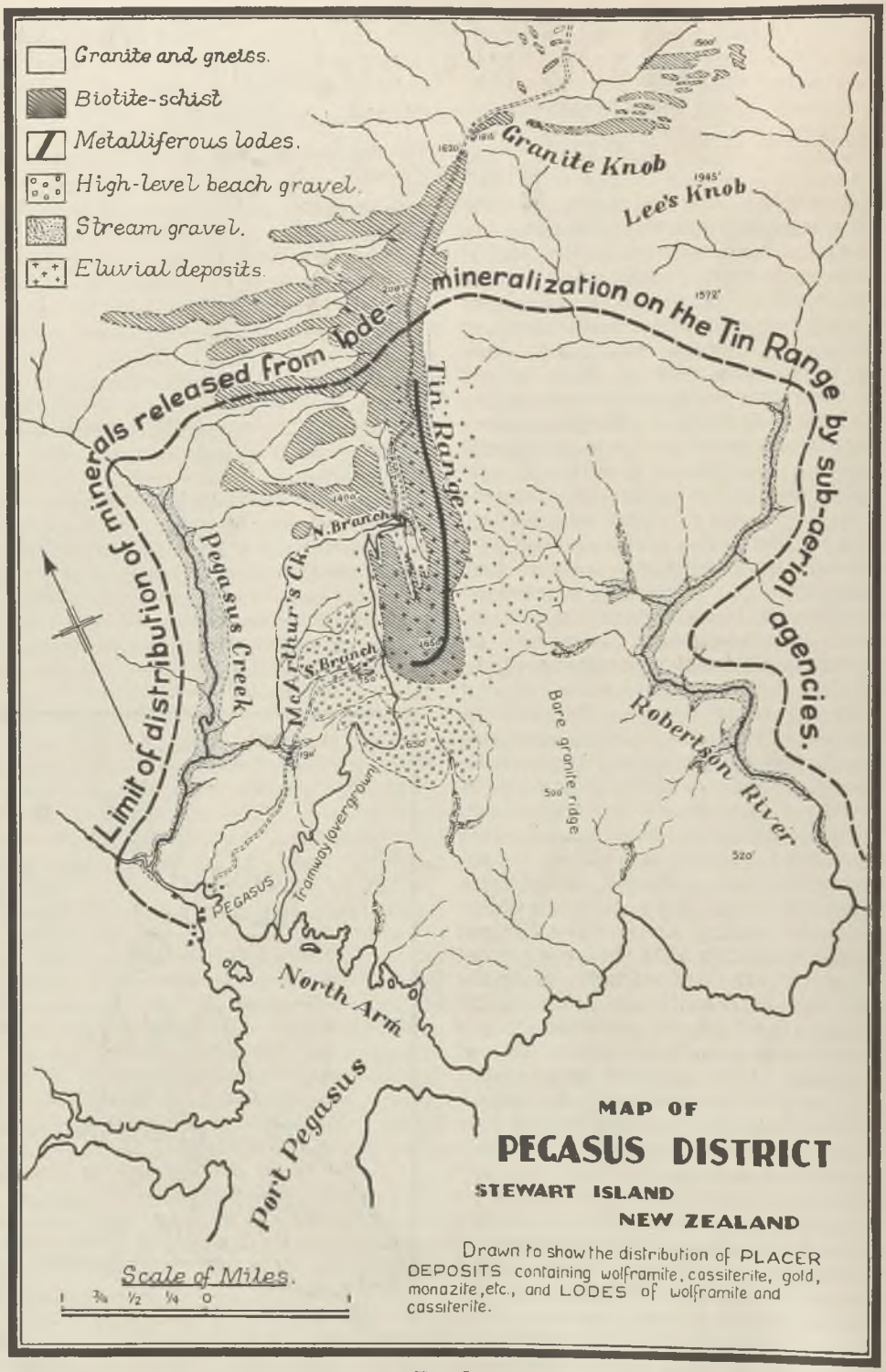
Granite and gneiss.
Biotite-schist
Metalliferous lodes.
High-level beach gravel.
Stream gravel.
Eluvial deposits.
Granite Knob
Lee's Knob
1945'
1572'
Limit of distribution of minerals released from lode-mineralization on the Tin Range by sub-aerial agencies.
Tin Range
N. Branch
S. Branch
McArthur's Ck.
Pegasus Creek
Bare granite ridge
Robertson River
PEGASUS
Tramway (overgrown)
North Arm
Port Pegasus
MAP OF
PEGASUS DISTRICT
STEWART ISLAND
NEW ZEALAND
Drawn to show the distribution of PLACER DEPOSITS containing wolframite, cassiterite, gold, monazite, etc., and LODES of wolframite and cassiterite.
Scale of Miles.
¾ ½ ¼ 0

FIG. 2.

swings round and disappears. Mineralization is strongest at the extreme south.

The regional trend of the biotite-schist is W. 20° N., a direction that is observed only at the extremities of the long tongues of schist that project westwards from the main body of the inlier in which the mineral lodes occur. In successive zones to the east a progressive swinging of the trend is observable and along the straight eastern boundary of the schist the strike is at right angles to the regional direction. The mineralized belt runs along the eastern flank of the inlier—i.e., it occupies that part of the schist which has received a superimposed orientation at right angles to the regional trend. It is suggested that the more or less meridional structure of the eastern flank of the inlier was impressed along the forefront of a newer granite mass (occupying the Robertson River basin) which was introduced under a pressure directed perpendicularly to the pre-existent foliations. The fugitive constituents of the main intrusion would be concentrated in the later intrusion. As it cooled, peripheral shrinkage parted the folia of the intensely-compressed schist along the forefront and afforded passages for the percolation of the late-stage metal-bearing ichors. In a westerly direction from the mineralized zone pneumatolytic effects became progressively less prominent and such quartz veins as appear are barren. At the southern end of the Tin Range, where the lode-zone swings round, it follows the crest of an isoclinal fold pitching steeply along the contact of the granite that had impressed the fold structure.

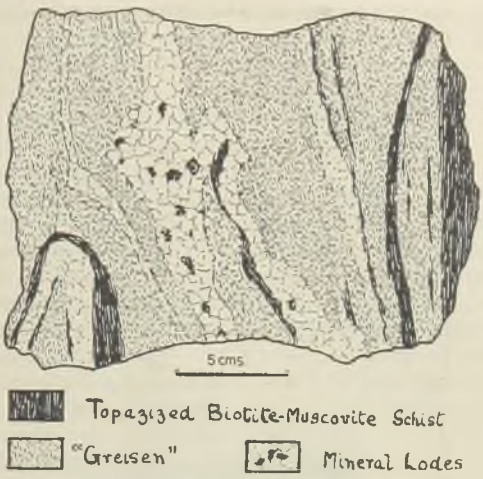

FIG. 3.

Form of Mineral Veins.—The individual veins in the metalliferous zone are irregular and anastomizing and form a typical composite vein system (Fig. 3). Only rarely do the veins exceed six inches in width, the average being of the order of one inch. Small scale " folding " of the veins, such as that shown in Fig. 3, is common. Close observation shows that wherever the veins

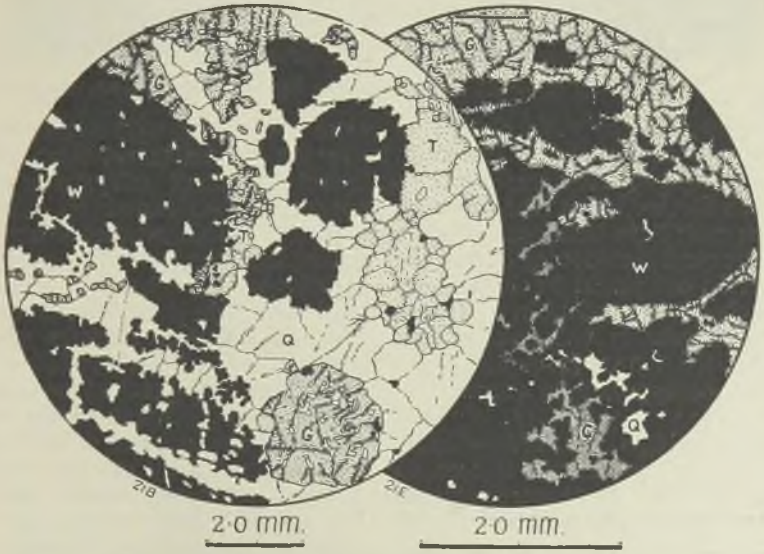

FIG. 4.—COMPOSITION OF THE METALLIFEROUS LODES: W = WOLFRAMITE; C = CASSITERITE; Q = QUARTZ; G = GARNET; T = TOPAZ.

present the appearance of having been folded they follow the bends of twisted laminæ of schist enclosed within the greisen. The minerals of the folded veins are not crushed. The contortions of the schist inclusions are not shared by the gneissosity of the host, which flows round them (Fig. 3, left-hand side). Hence it must be concluded that the folded veins were never plane and that the bends occur where the fracturing was guided by contacts between twisted fragments of schist and the "greisen" which encloses them. It is not ptygmatic folding as defined by Sederholm.

Tenure in Depth.—The granite-schist contact beneath the metalliferous lodes is not exposed, consequently the veins cannot be traced down into the granite; but from observations on non-metalliferous veins in schist pendants further north (the emplacement of which must have been controlled by similar dynamic conditions) it may be inferred that the lodes do not persist in the granite. The depth of the schist pendant in which the lodes appear is probably not greater than 200 ft., so that the tenure in depth of the veins may not be expected to exceed this distance.

Mineral Relationships in Lodes.—Under the microscope the lode material is seen to be made up predominantly of coarse-grained quartz. Topaz, which is usually turbid with minute inclusions of biotite, is unevenly distributed through the gangue in crystal aggregates, which frequently appear in fractures in ore minerals. Garnet (almandine with 2·33% MnO) is as abundant as topaz and also appears in cracks in the ores. The masses of wolframite that are so clearly seen in hand-specimen are composed of aggregates, the individual grains of which reach as much as one centimetre in diameter. The margins are rounded in detail and often surrounded by minute idiomorphs isolated in the gangue. Cassiterite is not common and occupies cavities in the surfaces of the wolframite clusters. The pleochroic colours vary from greyish brown to brown and the mineral has the characteristic blotchy appearance. In addition to these five main lode-forming minerals muscovite also appears, but in close association with remnants of felspar, showing its derivation from that mineral. Spinel (gahnite), sillimanite, and biotite appear only as xenocrysts that have been torn from the contact-altered vein-walls during injection.

Fig. 5.—Pegasus Creek—Fall over Band of Schist into Pegasus Harbour.

Order of Crystallization.—Wolframite and cassiterite were the first minerals to crystallize. The perfect cleavage of the former mineral rendered it susceptible to mechanical disintegration and each of the gangue minerals may be seen occupying parted cleavages and fractures, the sides of which were to some extent rounded by reaction with the vein-forming solutions, which later deposited a crop of minute idiomorphs round the periphery of the wolframite clusters—a redeposition that *followed* the crystallization of garnet and topaz. Of the gangue minerals,

garnet crystallized before topaz and quartz followed. It is not clear at what stage in relation to this sequence the felspar crystallized and reacted with the aqueous material of the lode-solutions to form muscovite.

Country Rocks.—The country rocks are of two kinds—a topaz-biotite-schist and a "greisen." The rock that is here called "greisen" encloses the lodes and consists of a fine-grained aggregate of quartz, topaz, and biotite. It has a sugary appearance in hand-specimen and crumbles on weathering, leaving the mineral veins in relief. It occurs in long well-defined zones, following broadly the structure of the schist. In the mineralized area the schist consists solely of a coarse-grained aggregate of more or less bleached biotite and turbid grains of topaz.

FIG. 6.—SOUTHERN END OF TIN RANGE: THE HILL IS CAPPED BY SCHIST, WHICH CARRIES THE METALLIFEROUS LODES. THE FOREGROUND IS THE GRANITE THAT EXTENDS BENEATH THE HILL.

GENESIS OF LODES.—It seems clear that the rock which is called "greisen" is *intrusive* into the topazized biotite-schist, for (1) the bands of greisen are sharply defined against the topazized biotite-schist and their margins contiguous to that rock do not present gradational stages in a process of progressive topazization and silicification of the biotite-schist, (2) contorted fragments of the schist appear within the greisen, and (3) a poorly-defined gneissic structure in the greisen flows round these included fragments.

It is equally clear that the lodes, in turn, are intrusive into the greisen. This is shown by the existence between the lodes and the greisen of relationships analogous to those just stated to occur between the greisen and the topazized schist. The intrusive nature of the lodes is also suggested by the fact that the intensity and disposition of the greisenization bear no relationship to the proximity of the mineral veins.

There appears, then, to have been three stages in the production of the rocks spacially related to the mineral zone—(*a*) the pneumatolytic topazization of the muscovite and felspar and the bleaching of the biotite of the granitized biotite-schist; (*b*) the intrusion along fissures of highly siliceous (liquid) ichor (the greisen) containing fluorine and water, which to some extent reacted with the topazized biotite-schist to abstract the material necessary for the formation of biotite in tiny plates in the greisen; (*c*) the greisen crystallized and later cracked along a series of anastomizing fissures following in a general way such rudimentary gneissic structure as it possessed. The cracks were occupied by tin-tungsten bearing fluids introduced soon afterwards.

Most mineral veins of the tin-tungsten type are believed to have been deposited pneumatolytically, but the writer's observations suggest that the Stewart Island veins formed from liquid solutions that entered a fissure system in a greisen-like rock. This conclusion is based on the following features: (1) The metalliferous minerals are restricted to the lodes, (2) vein-banding or comb structure were not observed, (3) garnets occur in the lodes in similar association and of the same variety as garnets appearing

in the pegmatites associated with the granite, (4) felspar (which was later almost entirely sericitized) crystallized in the veins, and (5) the ore minerals were introduced into the veins *in crystal form*—this is shown by their fracturing, by slight resorption of the fracture surfaces and redeposition of a late crop of minute idiomorphs around the crystal groups, by the crystallization in the fractures of all the gangue minerals, and by the general disposition of the ore-minerals away from the walls (although they are clearly the first minerals of the veins to have crystallized).

It is thought, then, that the mineral lodes were introduced in liquid form in much the same way as a pegmatite dyke is injected, that the ores were brought up from below as crystals with these solutions, and that the veins may be regarded as advanced pegmatites.

Fig. 7.—Neglected Alluvial Workings on Tin Range.

Placer Deposits.—The placer deposits may be divided into three groups—eluvial, alluvial, and beach concentrations.

Eluvial Deposits.—Under this head are included sparse deposits of cassiterite and wolframite that are scattered over the surface of the Tin Range and represent only an elementary stage in natural mineral concentration through which all minerals found in alluvial ground must pass. Under the abnormally wet and rigorous climatic conditions, the country rock surrounding the lodes is rapidly decomposed and removed, leaving piles of comminuted vein material that forms scree-slopes, beneath which the rain-wash effects a rough concentration of cassiterite, wolframite, and gold. Owing to the constantly changing surface of these slopes, however, the drainage is seldom concentrated in well-defined courses for any length of time, consequently such concentrations as form in riffles in the underlying bed-rock are patchy, but the occasional discovery of such a pocket inevitably leads to unwarranted optimism and subsequent disappointment. The position of these pockets, of course, bears no relation to the present contour of the scree-slope.

Alluvial Deposits.—Deposits such as those described (with some latitude) under the term "eluvial" grade imperceptibly into true alluvial ground. On account of the high relief of the island and the proximity of all parts to one or other of the deep coastal embayments, the formation of gravel and the concentration of valuable detrital minerals in well-defined drifts is restricted to narrow strips along the beds of the larger streams—the Robertson River and Pegasus Creek—in which local concentrations of gold and cassiterite were worked in the '80's. Small accumulations of gravel also appear here and there on the steep flanks of the Tin Range behind constrictions where streams cross hard bands in the granite.

Beach Deposits.—A thin veneer of metalliferous minerals is thrown up on the small coastal beaches during rough weather and such concentrations are preserved in remnants of a 10 ft. raised beach. A 650 ft. bench

flanking the Tin Range is covered with a shallow veneer of gravel containing some heavy minerals.

Detrital Concentrates.—The minerals in the detrital concentrates constitute an assemblage typical of an area mineralized by granitic ichor. Those identified under the microscope are (in order of abundance)—magnetite, cassiterite, almandine, wolframite, monazite, gahnite, epidote, topaz, zircon, rutile, quartz-sillimanitisé, tourmaline, sillimanite, scheelite, and gold.

AMERICAN GRAVEL- AND SAND-DRESSING PRACTICE

By H. G. SMITH, B.Sc.

The author describes current American practice in the preparation of sands and gravels for the market.

In considering this subject it is as well to remember that whether the raw material be obtained from a pit or from a river bed by means of dredging the dressing operations are fundamentally the same. In general the plants for the preparation of sands and gravels can be divided into two classes—

(1) Those in which the entire crushing of the material takes place before it is elevated to the top of the plant for screening and washing. This involves a crushing plant located between the receiving hopper and the main plant. All marketable material is separated and sent to the main plant, the oversize going to the crushers, where it is reduced to marketable size and again elevated to the main plant for washing and screening (Fig. 1).

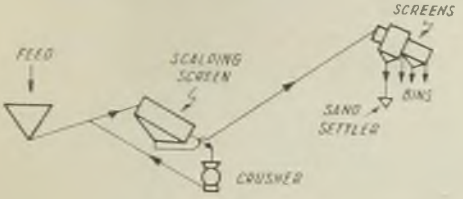

Fig. 1.

(2) Those plants in which all the oversize is sent along with the rest of the material to the top of the plant before any crushing takes place. In this class any oversize produced is passed to the ground, crushed, and re-elevated (Fig. 2).

There is, in addition, a subsidiary class of plant in which the material treated contains insufficient oversize to merit the installation of crushers. Sometimes the oversize is discharged into bins and sold to customers who crush their own material, or it is tipped to waste in the river. In such plants the feed may contain practically no material greater than 2 inches. A typical flow-sheet is shown in Fig. 3.

The first class of plant is generally found in places where large outputs—i.e., 1,000 cu. yards and over per 10-hour day—are required. The operating costs are cheaper, due to the fact that the material is only elevated once.

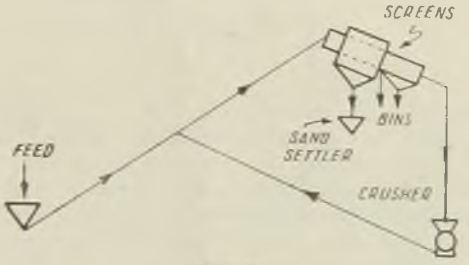

Fig. 2.

With plants of lower capacity this saving of power is not so evident, especially when skip hoisting is used as the means of elevation, and, moreover, the cost of such a plant is much higher than that of the plant required for the layout of the type 2.

The second class of plant lends itself more readily to adjustments for meeting the demands of the market for various grades of sands and gravels, as the crushing of intermediate sizes can be performed easily. Another possible advantage lies in the fact that crushed gravel, which is often required, can be conveniently prepared.

Scalping.—Scalping serves two very useful purposes—

(1) The removal of driftwood, roots and large boulders from the raw feed and

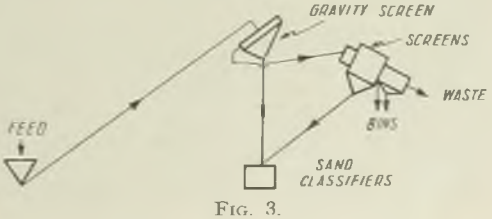

Fig. 3.

(2) To relieve the crushers of material already small enough to pass to the screens.

The grizzly forms a common scalping screen, especially where the feed does not contain flat stones which are apt to pass through the bars. Grizzlies with wedged shaped bars are often preferred to those made up of the ordinary flat bars, for the reason that they eliminate choking to a large extent. It seems common practice to arrange two

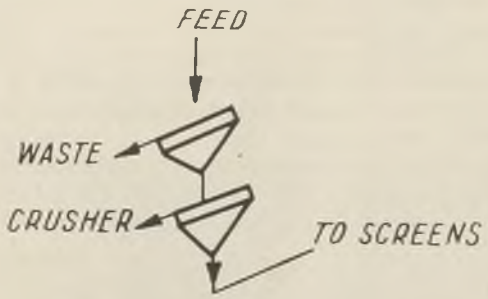

FIG. 4.

grizzlies in series as in Fig. 4. The first grizzly has spaces between the bars of, say, 6 to 8 inches, the oversize being sent to waste. The oversize generally contains most of the driftwood, boulders, etc. The undersize from this grizzly falls upon the second grizzly with closer spaced bars. Here the oversize passes to the crushers and the undersize to the screens.

In many cases the amount of oversize permits of primary and secondary crushing. In such cases revolving screens can be used with advantage as scalpers. These screens by-pass the larger oversize to the primary crusher and the smaller oversize to the secondary crusher, thus relieving the main screening plants (Fig. 5). The combination of a grizzly and a revolving screen with one set of openings is also sometimes used. This crushing is, of course, done dry.

Where the feed contains little oversize wire-cloth screens sometimes do duty as scalpers. At one plant where this method is used about 250,000 tons of sand and gravel are produced per annum, the amount of gravel above 2-in. ring in the feed being practically nil. The scalper used in this plant is an inclined wire-cloth screen of $\frac{1}{8}$-in. wire having $\frac{3}{8}$-in. square openings. The undersize from this screen passes to sand classifiers, whilst the oversize goes to the screens. This type of screen can only be used with any success where large volumes of water are available or where the material is pumped on to the screens. The inclination of the screens depends upon the amount of water available and the percentage of coarse material in the aggregate, the usual angle being 30 to 40°.

At another installation which produces 200,000 tons of sand and gravel annually the scalping screen consists of both a woven-wire screen and revolving screens. The feed, which contains practically no material over 2 in., is discharged on to a woven-wire screen made of 0·162-in. wire, giving openings of 0·338 in. The purpose of this screen is to separate the gravel from the sand. The oversize—i.e., the gravel—is sent to two revolving screens equipped with sand jackets and arranged in parallel. The inner section of the screen is punched with holes of $1\frac{1}{2}$-in. diameter, while the second jacket has holes $\frac{5}{11}$-in. diameter. Here all sand not removed by the wire screen is screened out and all roots and trash removed from the gravel.

CRUSHING.—The amount of crushing varies a great deal. In some cases, as already pointed out, there is not sufficient large material to merit the installation of a crusher, while in other cases there is sufficient to necessitate the installation of primary and secondary crushers. At a plant in Michigan, designed for a daily output of 16,000 tons, 1% of the feed passes through the primary crusher and 5% through the secondary crusher. There is, of course, the

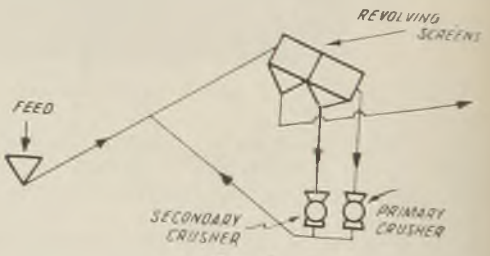

FIG. 5.

intermediate case, when it is profitable to install a crusher which cannot be kept going regularly. In the best practice the oversize is discharged into a bin and the crusher and its conveyor belt run intermittently.

In large plants where the amount of oversize is great stage crushing is invariably resorted to, the crushers being worked in closed circuit with screens of various types, but more often revolving screens. In such cases the crushing takes place before the material is elevated to the main plant and hence can be carried out dry, thus eliminating

the trouble associated with wet crushing. On page 8 of "Notes on Sand and Gravel Plant Design," by Munro and Barnes,[1] details are given of such stage crushing in large plants. In the class of plant in which the raw material is elevated to the top of the main screening plant the gravel oversize from the wet screens is chuted down to crushers. This gravel often contains water in sufficient quantity to cause crusher troubles. In many plants this is overcome by allowing the material to pass over a grizzly before it reaches the scrubber on the main screens. The undersize from this grizzly is allowed to pass on to the scrubber whilst the oversize joins the oversize from the wet screens and passes to the crusher. The addition of dry material reduces the percentage of moisture in the crusher feed and hence many of the difficulties are avoided. When the material going to the plant is necessarily wet—i.e., the product of dredgers, etc.—it is impossible to avoid the crushing of wet rock. In many cases perforated drainage bins and chutes are employed to eliminate water from the crusher feeds.

The types of crusher in main use are the jaw breaker and the gyratory (details of the various types of these are given in "Gravel Plant Washing and Screening Equipment and Design," by Hugo W. Weimer).[2] The former along with the larger types of the gyratory crusher appear to be employed as primary crushers, whilst the finer types of gyratory crusher are used for secondary crushing. The field of the jaw breaker seems to be for the crushing of material down to about 3-in. ring.

Jaw breakers are invariably used in plants of the first type where they may be employed in open circuit with a grizzly (Fig. 6). The types of jaw breakers in use are modifications of the Blake type of crusher with the largest movement of the jaws at the bottom. All the wearing parts are made of manganese steels. Roller bearings have also been recently fitted to this type of machine, enabling increased speeds to be employed with a resultant increase in the output and a saving in power. The present day primary crushers are likely to be able to meet all demands made upon them by the industry, but an increase in the demand for fine sand has resulted in much experimenting to find a secondary crusher with a high capacity and low power costs, but up to the present these experiments have not been wholly successful.

In Pennsylvania, where sand is at a premium, stage crushing is adapted to the breaking down of coarse gravels into fine sand. To do this jaw breakers, gyratory crushers, rolls, and hammer mills are employed. This is, of course, unusual practice. For material below 3-in. ring and in plants of the second type, where the amount of oversize is small in quantity, the gyratory crusher is adopted practically universally.

In rare cases the crushing machine is placed at the head of the washing plant.

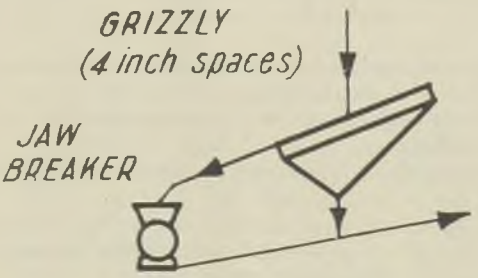

Fig. 6.

The vibration of these machines makes this inadvisable and where possible they should be mounted on concrete foundations and so located that they discharge into the same conveyor belt. Means should always be provided for the easy fitting of crusher renewals. It has been found advantageous in many cases to house all the crushers in one room and drive them from one shaft. A group of three or four crushers may have an aggregate of 200 h.p., but at the same time may be driven by a 150 h.p. motor, the reason being that all the crushers are never operating at full capacity at one and the same time. On account of the high starting torque slip-ring motors are invariably employed. Occasionally one finds a heavy friction clutch installed with the motor-driven pulley on the shaft.

Comparison of Crusher Types—

(1) *First cost* is in favour of jaw crusher.

(2) *Upkeep :* Slightly in favour of jaw crusher.

(3) *Form of Opening :* The jaw crusher is more desirable.

(4) *Product :* A much more uniform product

[1] Reprinted from a series of articles in *Rock Products*, 1928, 1929, and 1930. Chicago : Trade Press Pub. Corp.

[2] Reprinted from a series of articles in *Rock Products*, 1927, 1928, and 1929. Chicago : Trade Press Pub. Corp.

TABLE 1.

JAW CRUSHERS.

Size of receiving opening.	*Average weight in lb.*	*Size of output.*	*Capacity in tons per hour.*	*Average speed.*	*B.H.P.*
7 by 10	7,250	0·75 to 2	1·5 to 6	275	7–8
9 by 15	15,000	1 to 2·5	5 to 12·5	275	10–15
10 by 20	19,500	1·5 to 3	10 to 20	275	14–20
12 by 24	24,000	1·5 to 4	20 to 35	275	20–25
15 by 24	31,500	1·5 to 4	15 to 45	275	25–32
15 by 30	39,000	2 to 5	20 to 50	250	35–55
18 by 24	41,200	2 to 7	24 to 70	260	30–40
18 by 30	48,300	2 to 7	25 to 80	266	40–55
18 by 36	61,000	2 to 3·5	40 to 60	262	56–65
24 by 30	61,000	1·5 to 7	35 to 90	275	60–80
24 by 36	74,500	2 to 5	28 to 105	231	60–80
30 by 36	116,500	2·5 to 7	48 to 125	250	90–115
30 by 42	121,000	3 to 8	60 to 235	225	100–125
30 by 48	138,000	4 to 7	100 to 225	225	150
30 by 72	113,000	4 to 6	150 to 220	185	90–115
36 by 42	156,000	4 to 10	76 to 290	187	100–150
36 by 48	173,000	4 to 10	100 to 325	229	110–150
42 by 48	199,000	5 to 10	118 to 320	181	140–165

is obtained from the gyratory crusher and less slabs are produced.

(5) *Capacity:* Greatly in favour of the jaw crusher.

In Figs. 7 and 8 the layout of typical crusher installations is shown. In one type (Fig. 7) the product of the jaw crusher may pass on to the grizzly or go on to the screen. Jaw crushers are sometimes employed as secondary crushers. In one such installation (Fig. 8) the breakers are of the Dodge type with the greatest movement of the jaw at the top.

WASHING AND SCREENING.—There is an increasing demand for washed sand and gravels. Any raw material, no matter how clean it may appear, needs washing. Furthermore it is cheaper to wash material whilst screening than to screen it dry, as it has been found that water doubles the capacity of any

TABLE 2.

FIXED SPINDLE GYRATORY CRUSHERS.

Size of receiving opening.	*Average weight in lb.*	*Size of output.*	*Capacity in tons per hour.*	*Average speed.*	*B.H.P.*
6¾ by 70	9,650	1 to 1½	12 to 16	475	15
8 by 82	12,850	1¼ to 1¾	22 to 26	450	20
10 by 102	18,400	1½ to 2½	28 to 40	425	25
13 by 118	28,000	2 to 3½	60 to 130	340	40
16 by 148	47,650	2½ to 4	100 to 210	275	60
20 by 176	68,000	3 to 4	175 to 325	260	80
25 by 212	110,000	—	—	260	100

TABLE 3.

SUPPORTED SPINDLE GYRATORY CRUSHERS.

Size of receiving opening.	*Average weight in lb.*	*Size of output.*	*Capacity in tons per hour.*	*Average speed.*	*B.H.P.*
2 by 12	650	⅜	—	700	1–1·5
4 by 30	3,850	¾	2	500	3–4
5 by 36	5,900	1	4	475	5–8
6 by 42	8,400	1⅛	6	450	7–12
7 by 45	14,480	1⅜	10	425	10–16
8 by 54	21,700	1½	15	400	14–21
10 by 60	30,700	2	25	375	22–30
11 by 72	43,000	2¼	30	350	28–45
14 by 90	48,600	2½	75	350	50–75

screen. Accordingly in the United States dry screening is practically obsolete, except in cases where wet material introduces difficulties in the crushing system.

Scrubbers feature in practically all modern plants, due, no doubt, to the strictness of specifications and the fact that they are cheap to install and cost little to run. In plants where unit screens are employed the scrubber forms a separate unit, whereas in plants where the jacketed cylindrical screens are used the scrubbers form part of the main screens. Where scrubbers are employed the feed is fairly well cleaned before it enters the

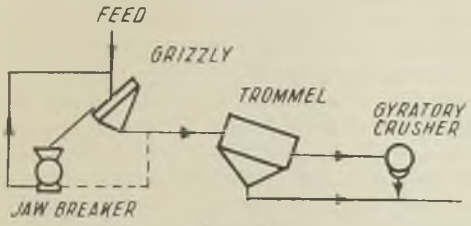

Fig. 7.

screens. Clay and loam are detached from the sand and gravel and a large percentage of the undesirable material goes into solution. Leaving the scrubber, the dirt-laden water with the sand passes through the screens to the settling tanks. It seems general practice to add two-thirds to three-quarters of the water used in the screening operations at the scrubber. The rest of the water is sprayed on to the material during its passage throughout the length of the screen, thus finally rinsing it.

Many of the modern types of washer make use of the ball-mill principle to break down the clay balls of exceedingly sticky and clayey gravels. The scrubber is divided up into compartments by means of retarding rings, which hold back the rock and coarse pebbles, but permit the finer material to pass on. The coarse pebbles thus help to break up the clay balls. Clear water is also sprayed in to wash away any loose fines off the balls. There is a tendency, when such clayey gravels are encountered, for the use of what is known as a washing box placed ahead of the scrubber and connected to it by means of a short flume. The feed tips off the elevator into this wash-box and here it is subjected to water under pressure, which disintegrates the clayey mass and washes it down the flume to the scrubber, which it enters thoroughly soaked. Thus the whole length of the scrubber can be employed for scrubbing

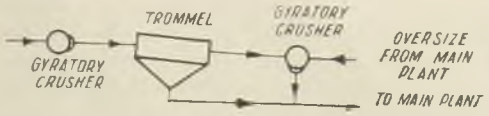

Fig. 8.

and not half of its length wasted by soaking the mass. Cases have been noted where the gravel, which is exceedingly sticky and clayey, has been washed in log washers before passing to the scrubber. This is, of course, expensive and is only carried out in districts where good gravel pits are scarce.

Screening practice in most parts of America seems to be very similar. In most cases it consists of primary screening with screens of the rotary type. The products from these are further sized when necessary by means of vibratory screens and sometimes, in the case of the finer sizes, with sand classifiers. In some cases the screening is entirely carried out by the rotary type of screen.

Whilst screening practice is more or less standardized, the types of screens used in the different localities vary only in such minor details as local experiment and experience have indicated as being most advantageous to the particular conditions. The chief types of rotary screen employed to-day in America are the conical and jacketed-cylindrical types. The former is the older type and is very popular even to-day in the smaller plants. The conical screens are generally supported on one shaft, although occasionally plants are found where each conical screen forms a separate unit. Although their distribution to the bins is good, they require a great deal of height, which amongst other things renders bin construction difficult and inconvenient. The capacity of the conical screens is low and though they are efficient at normal loads they become very inefficient when they are overloaded.

A typical flow-sheet of a modern screening plant is shown in Fig. 9. and demonstrates the use of conical screens. The products

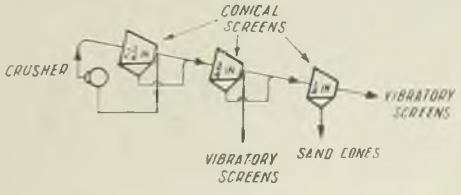

Fig. 9.

from these screens are rescreened on Hummer vibratory screens. Based on the output of the plant of a little over 1,000 tons per day, the equipment handles approximately the following percentages of material :—

Scrubber and $2\frac{3}{4}$-in. screen	100%
Crusher	3%
$\frac{3}{4}$-in. screen	100%
$\frac{1}{4}$-in. screen	70%
Vibrators	47%
Sand separators	45%

The plain cylindrical type of screen is made up in separate units for each grade. It has a high capacity, but requires a good deal of height and is not commonly used.

Jacketed-cylindrical rotary screens are most popular in the larger capacity plants. The first cost of these is rather high, but at the same time their use centralizes operations, the driving machinery is simplified, and little height is required. The modern type of machine is mounted on trunnions at both ends as opposed to the earlier types which were mounted on spiders and hung on a shaft passing through the inner cylinder. The jacketed type of screen may have one or even two jackets. The single-jacketed type, however, is the more popular, due to the fact that replacements of the various screens can be more easily and quickly carried out and the peripheral speeds of the primary screen and the jacket screen can be kept within the proper limits. With two jackets the peripheral speed of the outer jacket is too high for efficient operation. A typical flow-sheet using the jacketed screens is given in Fig. 10.

Another advantage of this type of screen and a probable reason for its popularity is the facility with which the products can be conducted to the various bins, thus lending itself readily to the mixing of the products for the various modern requirements. The lengths of the various sections of the screens can also be proportioned economically and

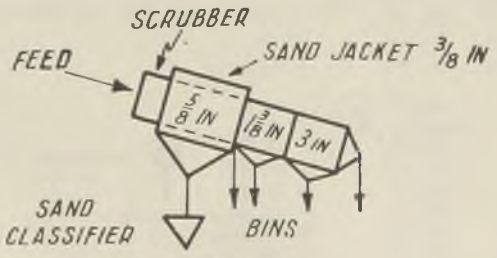

Fig. 10.

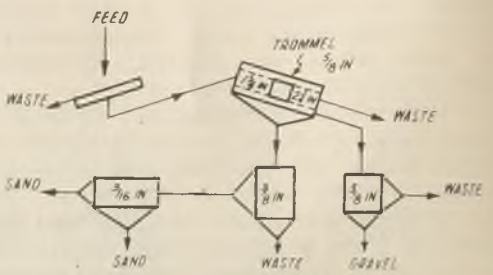

Fig. 11.

efficiently to the work done, thus assuring more accurate classification.

The use of the vibrating screen is practically universal in the United States for the screening of sands and gravels. This appears to be due to two reasons : First, a peculiar feature of the U.S.A's industrial requirements results in a surplus of material between $\frac{1}{2}$ in. and $\frac{1}{8}$ in. In general, the maximum size of sand particles usually recommended is limited to $\frac{1}{8}$ in., whereas the minimum size of gravel particles is limited to $\frac{1}{2}$ in. As a consequence of this, additional fine sizing is necessary in most districts and types of vibrator screens have been found to serve this purpose satisfactorily. Secondly, the overloading of rotary screens, which is common practice, has made it necessary for the rescreening of poorly-prepared gravels. The province of the vibrating screen seems to be for material exceeding about $\frac{1}{8}$-in. mesh ; below this size sand classifiers are mostly used. A typical example of the use of vibrating screens is represented by a plant of which the flow-sheet is given in Fig. 11. In this plant 750,000 tons of sand and gravel are treated annually. The size of vibrating screens is changed as required by market demands.

In screening the amount of water used can never be too great, each gallon increasing the capacity of the plant. Common American practice is to use one gallon per minute per cubic yard screened per 10 hour day. The waste is recirculated through the plant after settling.

Sand Settling Tanks.—These can be divided into three classes—

(1) *Automatic.*—In the automatic type the material is led from the screens in launders to the settling tanks. Here the sand settles to the bottom of the tank and the dirt-laden water passes off through an overflow at the top. When the sand accumulating in the tank reaches a certain level the tank tilts,

simultaneously opening valves at the bottom and allowing the clean sand to discharge. These tanks are usually made of steel and carry knife-edge fulcrums. They work very well for building sands, but for the finer grades of sand the bearings require careful attention, as these soon wear, causing sticking and hence "runaways." This type of tank dewaters to about 30%.

(2) *Stationary.*—These are built of wood, concrete, or steel. They are similar to the automatic type in construction, except, of course, that they do not discharge automatically and hence require the attendance of a man. They are not fool-proof and forgetfulness may cause flooding of the bins.

(3) *Power-Driven.*—These are fairly common and employ the gravity principle, the dirt-laden water overflowing and the clean sand sinking to the bottom of the tank. A conveyor drags the clean sand up the sloping side of the tank and delivers it in much drier condition than the soupy product of the automatic type. Where city by-laws prohibit the passage of dripping lorries along the roadways the power-driven type of settling tank has found great favour. Another advantage of this type of tank is that little head room is required. The disadvantages are that power is required, the first cost is high, the capacity is limited, and there is a tendency to lose the finer sands.

As a general rule settling tanks are arranged in one of the following three ways—

(1) Single automatic or power-driven tank, fed with the water passing from the screens, discharging clean sand to the bins and allowing dirty water to pass to a sump.

(2) One tank placed directly after the gravel screens, the overflow from the tank being divided between two other tanks of the same size.

(3) An automatic settling tank followed by a long surface current box. This method makes an excellent combination for a sand and gravel plant where two sizes of sand are required. The box gives the required area for classification and can be cut down until the required sizes are recovered.

STORING.—The amount of bin storage varies greatly. At some large plants where three or four loading tracks are employed no bin storage is provided except small hoppers to facilitate the loading of the trucks without spillage, whereas at others bin storage may be provided for 70 or 80 truck loads. A fairly large storage acts as an equalizer between temporary shutting down of the plant and a shortage of trucks. In large installations the elimination of delays amounting to an hour or two will pay for the construction of fairly large bins. Bins in practically all cases are of timber, but concrete or steel are found to be cheaper in the long run.

A combination of small bin storage and ground storage is often resorted to. It is made possible for the bins to discharge on to a horizontal belt which runs in a tunnel underneath the bins. The material travels along the belt and discharges on to an inclined belt, which in turn discharges on to an overhead belt which extends over the adjacent yard. This conveyor is equipped with trippers, which discharge the various grades at any desired point below. The material is afterwards loaded by means of an excavator into the trucks as required.

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MOTOR-LORRY TESTS

By S. V. GRIFFITH, A.I.M.M.

A comparison of cost factors obtained during a series of tests with six types of motor-lorry.

For the selection of the most convenient type of motor-lorry for use in a definite class of work it is necessary to make a study of minimum costs. If the lorries are of the same capacity it will be sufficient to determine the total costs per kilometre run and also to consider separately for each type of lorry certain factors which cannot be included in the running costs. It is customary to divide these costs into (A) those dependent on the kilometres run and (B) those independent of the kilometres run, as follows :

A.—*Costs dependent on the kilometres run.*

(1) Depreciation by usage.
(2) Expenditure for spare parts and maintenance.
(3) Depreciation of the tyres.
(4) Maintenance of the tyres.
(5) Expenditure for petrol, oil, and grease.

B.—*Costs independent of the kilometres run.*

(1) Interest on the capital invested.
(2) Insurance.
(3) Driver's wages.
(4) Garage.
(5) Taxes.
(6) Depreciation for age.
(7) Supervision.

The manner in which these costs per kilometre run are obtained from the results of statistics is given below—

A.—(1) *Depreciation by usage,* $70\% \frac{C'}{V}$, where C′ represents the cost of the lorry without tyres and V represents the life of the lorry in kilometres.

(2) *Expenditure for spare parts and maintenance,* $35\% \frac{C'}{V} \times c$, where c represents the factor of fatigue for the whole, the application of which will be shown further on.

(3) *Depreciation of tyres,* $\frac{C}{20{,}000} \times c'$, where C represents the cost of a set of tyres, c′ is a number proportional to the fatigue factor obtained by dividing the maximum weight on the tyre by the weight recommended for the tyre by the manufacturer, and 20,000 is the normal life of the tyre in kilometres.

(4) *Maintenance of the tyres,* $30\% \frac{C}{20{,}000} \times c'$.

(5) *Expenditure for petrol, oil, and grease*—For petrol 1 kilometre × price per litre of petrol ; for oil and grease 20% of the expenditure for petrol.

B.—(1) *Interest on the capital invested,* $7\% \frac{Co}{\text{Kms. per year}}$, where Co represents the total cost of a lorry.

(2) *Insurance,* $5{\cdot}75\% \frac{Co}{\text{Kms. per year}}$, 5·75 being an average figure obtained in practice.

(3) *Driver's wages,* $\frac{\text{Annual wages}}{\text{Kms. per year}}$.

(4) *Garage,* $\frac{\text{Annual rent}}{\text{Kms. per year}}$.

(5) *Taxes,* $\frac{\text{Annual taxes}}{\text{Kms. per year}}$.

(6) *Depreciation for age,* $20\% \frac{C'}{V} \times \frac{1}{\text{Speed}}$.

(7) *Supervision,* $\frac{\text{Annual cost}}{\text{Kms. per year}}$.

With reference to the depreciation of a lorry it is estimated that it has to be sold after a certain mileage at 10% of its cost, not taking into consideration the tyres. According to what has been previously stated a lorry will depreciate by 70% of its cost for usage and by 20% for age ; the latter item, which frequently is incorrectly included in the former, does not depend on the mileage

TABLE I

	White.	*Saurer.*	*Brockway.*	*Republic.*	*Federal.*	*International.*
Transport of rubble for 1 km.—Return trip, empty	0·399	0·361	0·360	0·287	0·374	0·242
Running loaded on a bad road	0·252	0·315	0·282	0·234	0·306	0·229
Running loaded on a good road	0·353	0·311	0·253	0·209	0·265	0·215
Running empty on a good road	0·250	0·266	0·238	0·175	0·245	0·188
Running loaded on a paved road	0·235	0·228	0·162	0·260	0·162	0·185
Transporting 20% over rated capacity	0·409	0·400	0·423	0·359	0·418	0·312

TABLE II

COSTS IN DOLLARS (*In Chilean Currency. At par £1 = $40 Ch.*).

	White.	*Sauver.*	*Brockway.*	*Republic.*	*Federal.*	*Intern'l.*
Price, including tyres	48,182·75	48,925·00	35,731·00	28,453·80	28,126·00	26,477·00
C'—Price without tyres	40,497·00	41,739·00	28,457·00	22,724·00	22,956·00	21,297·00
Kilometres per year	19,000	19,800	14,600	18,500	16,800	18,500
V—Life in kilometres	146,000	120,000	137,000	94,500	97,500	100,500
1/Speed	1·051	1·01	1·37	1·001	1·19	1·00
Horse Power, when new	47·2	33·65	32·9	30·2	40·25	31·2
c—1/life	0·82	1·00	0·88	1·27	1·23	1·2
65 kms. per day and 300 days per year						
COSTS PER KM.						
A.—*Costs dependent on kilometres run.*						
1.—Depreciation by usage—$70\% \frac{C'}{V}$	0·1940	0·2440	0·1460	0·1680	0·1650	0·1490
2.—Spares and maintenance—						
$35\% \frac{C'}{V} \times c$	0·0800	0·1220	0·0640	0·1070	0·1020	0·0890
3.—Depreciation of tyres—						
$\frac{C}{20{,}000} \times c'$	0·2943	0·2750	0·2776	0·2033	0·2138	0·1863
4.—Maintenance of tyres—						
$30\% \frac{C}{20{,}000} \times c'$	0·0883	0·0825	0·833	0·0609	0·0641	0·0557
TOTAL	0·6566	0·7235	0·5709	0·5492	0·5449	0·4800
B.—*Costs independent of kilometres run.*						
1.—Interest on capital invested—						
$7\% \frac{Co}{\text{Kms. per year}}$	0·1910	0·1780	0·1670	0·1145	0·1105	0·1050
2.—Insurance—						
$5{\cdot}75\% \frac{Co}{\text{Kms. per year}}$	0·1570	0·1460	0·1270	0·0940	0·0906	0·0863
3.—Driver's wages—$\frac{\text{Annual wages}}{\text{Kms. per year}}$	0·2540	0·2340	0·3000	0·2580	0·2530	0·2550
4.—Garage—$\frac{\text{Annual rent}}{\text{Kms. per year}}$	0·0113	0·0104	0·0133	0·0115	0·0112	0·0113
5.—Taxes—$\frac{\text{Annual taxes}}{\text{Kms. per year}}$	0·0113	0·0104	0·0133	0·0115	0·0112	0·0113
6.—Depreciation for age—						
$20\% \frac{C'}{V} \times \frac{1}{\text{Speed}}$	0·0628	0·0720	0·0554	0·0555	0·0530	0·0481
7.—Supervision—$\frac{\text{Annual cost}}{\text{Kms. per year}}$	0·1000	0·1000	0·1000	0·1000	0·1000	0·1000
TOTAL	0·7874	0·7508	0·7861	0·6450	0·6295	0·6170
GRAND TOTAL (without petrol, oil, and grease)	1·4440	1·4743	1·3570	1·1942	1·1744	1·0970
Transport of rubble, half load over 65 kms.						
Cost of petrol, oil, etc.	0·4150	0·3960	0·4150	0·3050	0·4200	0·2610
Grand Total, including petrol, oil, etc.	1·86	1·87	1·77	1·50	1·59	1·36
Running fully loaded over 65 kms.						
Cost of petrol, oil, etc.	0·3720	0·3940	0·2980	0·2984	0·3725	0·2730
Grand Total, including petrol, oil, etc.	1·82	1·87	1·75	1·48	1·55	1·37
Running partially loaded over 65 kms.						
Cost of petrol, oil, etc.	0·3480	0·3680	0·3705	0·2765	0·3450	0·2530
Grand Total, including petrol, oil, etc.	1·79	1·84	1·83	1·47	1·52	1·35
Cost of transporting rubble, half load over 65 kms.	1·86	1·87	1·77	1·50	1·59	1·36
Cost of running fully loaded over 100 kms.	1·61	1·67	1·54	1·32	1·39	1·21
Cost of running partially loaded over 100 kms.	1·58	1·65	1·51	1·30	1·36	1·19
Average of the three preceding costs	1·68	1·73	1·61	1·37	1·45	1·25
Per ton-kilometre	1·14	1·16	1·08	0·92	0·97	0·64

but on length of service and on the improvements in construction introduced by the manufacturers. For a motor-lorry of normal speed (represented by $\frac{1}{\text{Normal speed}} = 1$) the depreciation per kilometre is $20\% \frac{C'}{V}$ but for a lorry of abnormal speed the depreciation would be $20\% \frac{C'}{V} \times \frac{1}{\text{Speed}^2}$, because the life, in years, varies in inverse ratio to the speed.

Relative values.—To make a comparative study it is convenient to express all values in terms of the least. Thus, for example, in dealing with the fatigue of a piece it is assumed that the piece which gives the least result is taken as the basis for the others and is assumed to equal 1. The fatigue of the other pieces may then be expressed in terms of this value and will show the percentage by which they are greater than the basic factor.

Referring to the speed, which has been discussed above, this is calculated as follows : The average useful times of a series of tests are obtained and divided by the least, and the reciprocal of the result obtained is called the speed.

Kilometres per year.—For a motor-lorry working under normal conditions statistics show that 20,000 kilometres is the average run per year. Multiplying this figure by the speed, as obtained above, the kilometres run per year are obtained for the lorry.

Factor of fatigue for the whole and the life in kilometres.—The factor of fatigue of the whole is equivalent to the average of the fatigue values of the most important parts of the lorry ; for heavy lorries, owing to there being less vibration, this is estimated as being 30% less than that calculated. The relative value of the life of the lorry is taken as being equivalent to the reciprocal of the factor of fatigue of the whole.

The life in kilometres of an average lorry is taken as being 120,000 kilometres. This figure multiplied by the reciprocal of the fatigue factor—i.e., by the relative value of the life of the lorry—gives the life in kilometres of any special type of lorry.

Consumption of Petrol.—In Table I consumption of petrol in litres per kilometre is given for six different makes of motor-lorry.

Finally a table of costs is given in Table II, which summarizes the previous items, and from this table it will be seen that the cost per kilometre is calculated on the basis of 65 kilometres and 100 kilometres run per day with half and full loads. The cost per ton-kilometre is calculated on the assumption that the lorry works for equal periods in the transport of half-loads of rubble over 65 kilometres per day and running with half and full loads over 100 kilometres per day.

LETTER TO THE EDITOR

"The American Debt"

SIR,—Your editorial on the American Debt in the January issue prompts me to write to you. I do this with hesitation, but in memory of my own service in the position you fill and memory of many kindnesses I received while a resident of your country or other parts of the great Commonwealth of British nations.

May I say first that I think no public discussion of this subject should be attempted which is not designed to be helpful and to clear away difficulties rather than to stiffen opposition. With that in view I venture to take issue with you on a few points, because I think your editorial assumes a state of facts which does not exist or fails to take account of American public opinion that must be considered. For example, granted freely that you are right that "there would seem to be no two opinions on the point that under the conditions now ruling both creditor and debtor nations are adversely affected," why then is it "incumbent on the United States" rather than on "both creditor and debtor" to come to some settlement ? Isn't it a new notion that a creditor should settle with a debtor rather than the reverse ? And if we are both interested why this objection to discussing all the circumstances ?

It is our belief, though I really believe American opinion is open to conviction on it, that settlement of the debts is but one element in the present world impasse. If we are asked to accept your opinion on this one element why should you not at least consider ours as to others ? Are you so sure that debt settlement will clear up our difficulties ? While that has been alleged frequently no such array of facts has as yet been presented as has convinced American opinion. With the best will in the world to believe it, I may say that so far I have not myself seen the reasons for doing so. If Americans can be convinced

that giving up the debts will cure the depression they are clear headed enough to see that the cost will be much less than present losses, but is there any reason why those who urge this should not present convincing arguments ?

As to the facts regarding the debts, your Government and others have been scrupulous in never contesting their validity. Your editorial, however, reflects an opinion rather widespread outside our country, but held only by a small minority here, to the effect that they do not constitute a moral claim because, as you phrase it, America " paid mainly with dollars, whereas the other countries paid mainly with lives." This, of course, can only stand on the basis that it was our fight from the first as much as yours. As to this, I can only say that even now, over eighteen years after the beginning of the war and after most active and persistent propaganda to convince us of your point of view, American opinion is in vast majority unconvinced. The alternative opinion is that Europe as a whole failed so to conduct its affairs as to keep the peace and that only after two years of war, as a result of more and deeper invasion of our rights by one set of participants than by the other, we were forced to take sides to restore peace. When we did that we withdrew claiming none of the spoils, whereas I believe each of our allies came out with enlargements of area and position to offset in some small way their losses. We even found they had made secret agreements among themselves as to division of territory which blocked the carrying out of such ideas as we had of the establishment of general peace. We may not be wholly right in this point of view, but it is the one held here so completely that as wise negotiators you should know it and reckon with it. It is useless to assume that we, as a nation, will accept the other.

In another regard European opinion is misinformed. It is not true that all the money our Government loaned was spent in this country, in fact, whatever may be the technical position, and I believe I am right even as to that. A considerable amount of that advanced to the British Government was used to peg the pound so that, for example, a smaller number of pounds was spent in neutral countries than would otherwise have been necessary. I am also under the impression, and the public here believes, that we actually furnished at times credits abroad. If we are all wrong as to this it would be a useful thing to clear up. Other things which enter into our judgment as to the moral value of the debts are such circumstances as that European governments purchased here food and other supplies giving our Government notes and then sold the supplies, at times at a profit, to their own people and received cash. Another is the circumstance that all purchases made by our allies in our markets were made at the same non-commercial price our own Government paid, whereas when we came to buy we only obtained the same prices, as in the famous case of jute bags for shipping grain, after strenuous representations if at all. Another is that whereas our allies paid us in notes we paid them, when we supplied our soldiers abroad through their own money, with cash.

There have been many proposals to wipe out the notes, but I do not remember ever hearing one to first offset the cash we paid out in Europe. You mention the fact that your Government became responsible for various credits made to other allies, but apparently you are unaware of the fact that in passing on these credits they were loaded with increased interest charges or political concessions to such an extent that our Government felt obliged to insist on being allowed to lend its money direct. Finally, our opinion as to the debts is influenced by the fact that on the basis of present values—and mining engineers especially need no argument as to the validity of such a basis—in our settlements with our allies we indirectly did free them from all but post-Armistice debts, even including those incurred in taking up on maturity loans made here in the private market before we entered in the war. I make haste to add that I am not sure this concession was fully equal to the war loans in the case of your Government ; but in general the whole bother is not about war loans in fact, but about post-war reconstruction loans.

It is also to be remembered that the settlement was based upon " capacity to pay," which is the normal basis of settlement when a debtor finds himself involved. If Europe is able to pay we see no reason why we should as individuals pay taxes to retire bonds floated to furnish money to Europe. If Europe is not able to pay that is another matter, and American opinion is entirely agreeable to reconsideration at any time of the facts as to that. If, still, Europe is able to pay but chooses not to do so, that is still another matter, and there has never been any suggestion of an attempt to collect by force. How-

ever, a debtor who can pay but will not may well find, as Russia has, it very difficult to establish his credit again. I have sometimes wondered whether a default frankly admitted to be such might not be the best solution. Such a termination of inter-government war debts would, I believe, operate to localize any future wars, for what people would buy securities to finance such a war with such a precedent ?

May I say just a word, too, as to some of the things we think you might fairly sit down and discuss with us while the talking is going on. To put it badly, I have never seen just why I, as an individual, should be taxed to support the French Army or the British Navy, however useful they may be. Yet if either government spends its money on such things it obviously lacks by so much the money to pay its debts and up go my taxes to make up that deficit. Forgetting the French Army, our point of view as to your Navy is this : However much we may fail for a time to build up to your standard—and the failure is due to a desire not to rush matters and in hopes still of persuading you to come down a bit—few things are more settled as a matter of public policy than that we shall have a navy second to none. A lot could be said as to how that comes about, but you may take my word for it that this is so. To us the important thing is that the two fleets shall be equal and except for cost the absolute size is not important. Certainly two much smaller fleets, with the will to work together and a friendly public opinion to enforce that being done, would be ample to take care of any third disturbing element. As we see it, you might well cut your Naval costs as much or more than your agreed annual payment to us, keep the money at home, and by thus allowing us to save an equal amount we would get the compensation for the debt and both nations would benefit. We do not presume to insist this be done before debts be considered, but we see no adequate reason why debts must be wiped out without compensation before you consent to consider such settlements. With the superb record of ability as traders that the British have built up, we fail to understand their disinclination to enter a conference even with Yankees without prior assurance that they shall have their own way. However, I suppose that is just another instance of the ways of diplomats and is not to be taken seriously. If you do take it so, you are bound to fail and that would be a great pity, since it is so important for the peace of the world that our two peoples should see eye to eye as far as possible. My desire that this should come about is my excuse for writing you on this non-technical matter at such length and, in spots, so provocatively. You are welcome to use any of this material as you like, but my main purpose has been that you should see how it looks to a sincerely friendly American.

H. Foster Bain.

New York City.
February 13, 1933.

BOOK REVIEWS

The Genesis of the Diamond. By Alpheus F. Williams. Two volumes, cloth, octavo. 636 pages, illustrated. Price 84s. London : Ernest Benn, Ltd.

It is particularly appropriate that Mr. Alpheus Williams should have crowned his distinguished career as general manager of the De Beers Consolidated Mines with the publication of these two sumptuous volumes. For over thirty years the problems connected with the origin of kimberlite pipes and their rich and varied contents have engaged his attention to such purpose that not only has he made unrivalled collections and innumerable field observations, but in addition he has given up much of this time to laboratory research bearing on the subject. Moreover, he has played a leading part in stimulating other workers to lend their technical skill and contribute their results to the accumulated wealth of knowledge now so handsomely made available. The petrographic investigations have involved the study of over five hundred thin sections, many of which have been described by Professor C. G. Cullis. Special mention is also made of Mr. J. Parry, chief chemist to the De Beers Company, who has provided an invaluable suite of chemical analyses of the chief rock-types and minerals occurring in the diamond pipes.

The book is lavishly enriched with illustrations. Among the many beautiful plates well over a hundred are devoted to photomicrographs of kimberlite and its inclusions and of these twenty-six are very effectively reproduced in colour. The diamond itself and its various stages of growth are illustrated by another long series of finely-executed photomicrographs. Mr. Williams is not only a persuasive writer

but also a photographer of unusual taste and skill.

The book opens with a chapter on present-day methods of diamond mining and recovery. The next eleven chapters, overflowing into the second volume, are devoted to kimberlite and its origin, every significant aspect being exhaustively dealt with: Occurrences; geology; pipes and fissures and their origin; physical and mechanical changes; chemistry and petrography; accidental and cognate inclusions. The theme progresses through a rich variety of topics with leisurely thoroughness and, despite the frequent holding up of the evidence or argument by long citations from other authors that are not always worthy of inclusion, there are many sections packed with newly-recorded data and inferences therefrom that amply repay careful study.

There can be no reasonable doubt that the parent magma from which kimberlite and its cognate inclusions were derived was of very deep-seated origin, but the author's contention that the kimberlite magma occupied reservoirs of continental dimensions underlying the basaltic layer seems to be inconsistent with his view that kimberlite was produced from the residual magma that remained after the solidification of the rocks forming the peridotite layer of the lower part of the crust. The production of a residual magma implies differentiation, which in turn implies separation of crystal phases from fluid. It is difficult to believe that there could be any effective separation under the conditions of high viscosity that would obtain at depths below the basaltic layer. Now there is much evidence that kimberlite does represent a residual magma. Its peculiar geochemistry, its spectacular association with the products of gas explosions, and the low temperature of the magma that rose into the pipes all point irresistibly to this conclusion. It may therefore be worthy of consideration that the main differentiation of the parent magma took place, not at the base of the crust, but in the network of fissures by which the crust was shattered before the pipes were blown through to the surface.

There is definite proof that many of the pipes were occupied by fragments of the superimposed strata before the kimberlite magma rose up and incorporated them. This suggests that the gases concentrated in the residual magma by the progressive crystallization of ultrabasic aggregates gradually accumulated above the magma until their internal pressure became adequate to perforate the crust in an explosive outburst. The author considers that at least the upper part of the fissures on which the pipes are situated were also produced by this process and that pipe formation was only fissure enlargement within a few thousand feet of the surface. It is of interest to observe that pipe formation, even from such limited depths, implies the operation of pressures at these depths that are of the same order as the dead-weight pressure that would be exerted at the base of a crust 100 km. thick. It may well be, therefore, that the high pressures implied by the crystallization of diamond and the minerals of eclogite were to an important degree inherent in the kimberlite magma itself and were not necessarily a function of great depth, as has generally been assumed. This conception may possibly account for the remarkable fact that the kimberlite occurring in narrow fissures has been universally found to contain but few diamonds. There is generally a steady decrease in yield with decrease in the width of the fissure. Moreover, the diamond content varies as between one mine and another, and even between different parts of the same mine, in respect of quantity, colour, and crystallographic development.

The tentative explanation of this variation in character and impoverishment in depth given by Mr. Williams is on the following lines: Crystallization of carbon into diamond started on a limited scale at the time when the plutonic rocks now found as cognate inclusions were solidifying. In the residual magma then left the conditions for diamond formation became more favourable owing to the growing concentration of carbon compounds, the crystallization of diamond reaching its maximum before the ascent of this part of the magma into the fissures and pipes. This enriched portion "in turn rose and intermixed with semi-plastic magma already filling the pipes." The reviewer fails to understand how this process can account for the fact that all mines become poorer in depth. He prefers to consider the hypothesis that the diamond crystallized for the most part at depths near the level from which the pipes were afterwards opened out, the environment being one in which volatile carbon compounds were abundant and gas pressure was extremely high.

Mr. Williams clearly demonstrates that the diamond crystallized at the same time as the porphyritic crystals of olivine, enstatite, garnet, chrome-diopside, phlogopite, and ilmenite and was transported with these crystals by the magma that later solidified as a fine-grained matrix of mica and olivine. He considers that the whole complicated network of fissures that existed beneath a vast area of South and Central Africa represented the channels through which the kimberlite magma passed from the deep-seated reservoir to the surface. The pipes naturally became the chief outlets, but they are not, according to Mr. Williams, to be regarded as volcanic necks that served as the feeders of former volcanoes. The validity of this view depends, of course, on the definition of a volcano. There are good reasons for surmising that the comparatively recent explosion craters of Uganda provide a picture of what the surface phenomena were like (see *Quart. Journ. Geol. Soc.*, 1932, p. 370).

In the course of his detailed study of the cognate inclusions Mr. Williams devotes much attention to the eclogite problem. The petrographic descriptions and the many new analyses that are made available constitute an important contribution to this controversial question. It is concluded that "the bulk of evidence is in favour of these particular inclusions being all of igneous origin and genetically related to the magma from which kimberlite was derived." The possibility of accidental inclusion of metamorphic eclogites is not denied, but such types are thought to be rare. It should be recognized, however, that the evidence cannot yet be regarded as conclusive. In collaboration with Professor F. Paneth the reviewer is at present investigating this problem by a new method which seems likely to lead to positive results. By estimating the ages of eclogite inclusions, using the accumulation of helium within them as the criterion, it should be possible to decide whether a given inclusion is of the same age as the kimberlite and therefore cognate with it or considerably older than the kimberlite and therefore accidental.

In Vol. II Mr. Williams gives a very full account, enriched with much new data, of the varieties and characteristics of diamonds, their crystallography, physical properties, chemical composition, etc., in the course of which he discusses the origin and growth of the diamond. The section on genesis contains a good summary of the various hypotheses that have been put forward, but little is added to the conclusions already reached in the chapter on the origin of kimberlite. In view of the title of the book and the importance of the subject a chapter systematically devoted to the origin of diamond would have been specially welcome.

The work concludes with a long and well-illustrated chapter on the diamond-bearing alluvial gravels of South Africa. Mr. Williams' close association with the amazing discoveries made in recent years, his intimate knowledge of the whole territory, and his personal acquaintance with the leading geologists and prospectors concerned have enabled him to make a contribution of unrivalled authority to one of the most fascinating aspects of the distribution of diamonds, one which is important geologically as well as economically and full of human interest besides.

Differences of opinion as to preferred hypotheses are of little consequence at this stage of our knowledge; the facts abide, though their explanation still eludes us. It is the outstanding merit of Mr. Williams' book that it places on record a vast collection of pertinent facts that have hitherto not been available. The volumes themselves are magnificently produced and both author and publishers are to be congratulated on the issue of a work that is thoroughly worthy of the dignity of its subject.

ARTHUR HOLMES.

Phosphat-Nitrat. By Dr. OTTO STUTZER and Dr. W. WETZEL. Paper covers, 390 pages, illustrated. Price: paper covers, 32 RM.; cloth, 34 RM. Berlin: Gebrüder Borntrager.

This is one of a series of volumes dealing with the chief non-metallic minerals published under the general editorship of Professor Otto Stutzer, who is responsible also for the first part of the present volume on phosphates. The first volume of the series dealt with graphite, diamond, sulphur, phosphates; Volume 2 with coal and the geology of coalfields; and Volume 3 with oil and oil fields.

The part dealing with phosphates, pages 1 to 293, is a second edition of what was published in Volume 1 in 1911. It has been largely rewritten and much extended and

includes a valuable new chapter on phosphates in Russia contributed in part by Professor Granigg-Loeben. The first 54 pages are concerned with various phosphate minerals, their mode of occurrence and origin, their exploitation and marketing ; pages 55 to 293 give a detailed description of the chief phosphate deposits of the various countries, this whole section on phosphates being illustrated with 93 clear reproductions and well annotated.

Nitrates, by Professor Wetzel, of Kiel University, a well-known specialist on this subject, occupy pages 297 to 369, with 18 illustrations. This part is on much the same plan as that adopted for phosphates and, like the latter, it contains a good deal of reliable and detailed information not hitherto published. Two folders—one a map of Chili showing the location of the chief nitrate deposits, the other of 24 sections of the nitrate field of Prosperidad, Toco—and a full bibliography of the most recent literature on the subject complete one of the most authoritative accounts of nitrate minerals and the nitrate fields of the world that has so far been published.

WILLIAM R. JONES.

Petrography and Petrology : a Textbook. By Prof. F. F. GROUT. Cloth, octavo, 522 pages, illustrated. Price 30s. London : McGraw-Hill Publishing Co.

The two-fold title describes the general plan of the book, which proceeds from systematic description to the more exacting problems of interpretation. Rather more than half the text-matter and illustrations is devoted to igneous rocks ; the rest is about equally apportioned between the sedimentary and the igneous rocks. Criteria of rock-types and copious synopses of fact are tabulated at frequent intervals and the main theories concerning genetic and other processes are stated and discussed. A list of selected readings and a set of determinative tables form a useful appendix. The author is conservative with regard to nomenclature and labours no personal views ; he assembles the liberal equipment necessary for a rational interpretation of field-observations and laboratory data.

The book embodies an astonishing amount of information, which is well and clearly presented. The " live " work on which modern petrology is based has been zealously abstracted from a wide range of geological and mining literature and is made accessible within the limits of a single volume which will commend itself to petrologists and mining geologists alike. Not unnaturally, mild exception may be taken here and there to relatively minor points—e.g., the grouping of theralites and essexites with the diorites ; the omission of trondhjemites ; the presumed obsolescence of the term " porphyrite " ; a three-fold (and inconsistent) definition of malchite and some inadequacy in the treatment of the sedimentaries.

A. BRAMMALL.

A French-English Vocabulary in Geology and Physical Geography. By G. M. DAVIS. Cloth, octavo, 140 pages. Price 6s. London : Thomas Murby and Co.

It is the common experience of English geologists, when reading French geological literature, to be puzzled not by the strictly scientific terms in that language, taken for the most part from Greek and Latin sources, but by commonplace words used in a semi-technical sense, the precise meaning of which in their geological application is often not included in technical dictionaries. The author, who is Reader in Geology at Birkbeck College, University of London, has solved these difficulties with conspicuous success. He has omitted words which differ but little from their English equivalents and thus present no difficulty, but has included a host of words innocently English-like in spelling but very different in meaning. *Magnésite* is not magnesite but meerschaum and *inhabité* is the opposite of inhabited ; scores of such words are included, together with mining, stratigraphical, and other terms not so clearly and correctly explained in any previous publication with which the reviewer is acquainted.

The majority of English readers of French literature dealing with geology, mining, and physical geography who neglect to provide themselves with this very helpful little book will waste a good deal of time in consulting voluminous technical dictionaries, often without obtaining the precise information they require.

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.

NEWS LETTERS

JOHANNESBURG

February 2.

Gold Mining Industry's New Policy.—South Africa having departed from the gold standard the Transvaal gold mines are now obtaining in local currency a much higher price than formerly for their production. Many important questions and problems arising from the new situation have been receiving careful attention from the Chamber of Mines. It is believed that under the new conditions a new mining policy will be evolved under which ore that previously had to be regarded as unpayable will be brought into profitable production. Inability to raise sufficient fresh capital to sink additional deep-level shafts and for other major purposes has been a serious factor in limiting the scale of operations, restricting the exploitation of less promising reefs and areas and curtailing the prospective life of various mines. It is certain that many programmes of capital expenditure can now be contemplated by ear-marking for the purpose a proportion of the increased profits that should be earned in the future. After all such measures have been taken the proportion of profits available for distribution as dividends should show a substantial increase. In general, the attractiveness of mining investments will be enhanced. Fresh capital for mining and, indeed, for all industrial enterprises will, in consequence, be more readily forthcoming, so that general expansion and a great enlargement of the scope for employment may be anticipated. The increased price of gold should give a fresh and much more favourable lease of life to the large and small gold mines in the outside districts and greatly stimulate interest in the undoubted gold mining possibilities of the Klerksdorp, Heidelberg, and other areas. The higher prices in local currency now obtainable for their exported products must also materially improve the outlook for all other branches of mining. Diamond, coal, and base metal enterprises, all of which have suffered either a suspension or a contraction of operations, will be able to consider a resumption or expansion of production to a degree that, at the least, will make an important contribution towards the improvement of the economic situation and the relief of unemployment.

Western Rand Extension.—It is understood that Dr. Nel, a senior member of the Geological Survey, has been specially detailed by the Government Mining Engineer to keep in touch with developments on the Western Rand Extension and, when the drilling programme is completed, he will furnish a report to his department reviewing the company's operations and its prospects. Unpublished field notes and other data obtained in the area of the Western Rand Extension have been placed at the disposal of the engineers and experts of the New Consolidated Gold Fields by the Geological Survey. This information was on file in manuscript form at Pretoria and was offered as an earnest of the practical help which the State desires to afford in opening the new field. Besides his work of inspection Dr. Nel has for some time been engaged on the preparation of a highly important aid to prospecting—a new sheet of the Geological Survey map of the Union. Hitherto the South-Western Transvaal has been inadequately investigated from this point of view and the need of a fresh sheet has become urgent since the extension was identified. An area lying roughly around Klerksdorp, Potchefstroom, and Ventersdorp, about 100 miles square, is included in the new diagram, which is likely to be completed during the year. Additions covering the country down to Parys will follow.

West Witwatersrand Areas.—The borehole which is being put down on the West Witwatersrand Areas' farm Venterspost has passed through the dolomite and is now in the amygdaloidal diabase overlying the Witwatersrand formation. Another borehole was started recently on one of the farms over which the company holds an option. Venterspost is one of the farms of the Western Areas block. The mineral rights of this block were purchased from Messrs. Donaldson and Carlis for £220,000.

Witpoort No. 14.—It is understood that in the event of the prospecting operations on the South African Land and Exploration Company's portion of the farm Witpoort No. 14 disclosing encouraging values it will be worked as a separate entity. West Springs' and Brakpan Mines' haulages have reached the boundary of Witpoort and can be expeditiously extended into the property. Signs of improvement in the southern portion of the West Springs mine will no doubt play a big part in deciding the question of completing the No. 2 shaft (which was

discontinued at 3,000 feet) at an early date. In the south-west portion of the mine another bore-hole has yielded highly payable results.

Platinum in Rhodesia.—Thirty blocks of platinum claims have recently been pegged and registered in the Gatooma district, Southern Rhodesia, by Mr. McD. Stokes, an experienced miner. The claims are located on the Umsweswe River, about four miles west of Devon Farm. When the Transvaal platinum boom had reached fever point there were reports current of rich deposits of the metal in the Belingwe area and the Southern Rhodesian Government gave financial support to an investigation at that time, but nothing came of it, though thousands of claims were pegged.

VANCOUVER

February 10.

Cariboo.—The situation in regard to claim-staking in the Barkerville area is described as having reached fever heat. Claims are being located on the snow with little regard to overlapping on the off chance of picking up fractions that may have been overlooked. The sudden burst of activity that has developed during the past few months is all the more remarkable when it is remembered that the operations of Cariboo Gold Quartz Mining Company, upon which all interest centres, have been in progress for some years and some at least of the results upon which the new optimism for lode-mining prospects in the area are based were published a year ago. Pending receipt of advices as to the results obtained by the Cariboo Gold Quartz Mining Company since regular milling operations were commenced a month ago it can only be reported that work is proceeding and that, according to the management, the treatment plant is giving satisfaction. The stages by which this property has reached production are more or less unique in that no sufficient reserve of positive ore is reported to have been blocked out and the claim of development is based upon a remarkable succession of discoveries by which this deficiency is adjudged to be offset to a competent extent. Burns Mountain Gold Quartz Mines, Ltd., has been formed to acquire properties situated on the southern slope of Burns Mountain. The claims include the old Perkins location and cover vein occurrences upon which the largest amount of underground development in the Barkerville area was done, when lode-mining was first thought of. In 1878 J. B. Beedy, of Lightning Creek, is reported to have obtained encouraging results from oxidized outcrops and later a considerable amount of tunnelling work was carried out by the Burns Mountain Quartz Mining Company, but this work was abandoned and subsequent activity was again confined to the outcrops and to shallow workings. The present owners of the property opened up some of the old tunnel workings recently and discovered veins with sulphide mineralization carrying gold values. With the proof of gold values in the sulphide zone the conditions on this property would appear to be a repetition of those encountered in the Cow Mountain developments and represent a good prospect. The property of the Cariboo Yankee Gold Mining Company, situated on Yanks Peak, lying to the south-east of the Barkerville area proper, has been the subject of various reports. A number of veins are known to occur and a considerable amount of surface exploration has been carried on in former years. Three tunnels were also driven for distances of approximately 100 ft. each on individual veins and some high assays have been reported. It has been reported that the present company will carry out a scheme of deep development, but it is suggested that more careful examination of the surface exposures might be advisable in the first instance. Yanks Peak lies in the intermediate mineralized zone as described by the resident engineer, which includes Burns Mountain.

Bridge River.—The report of George A. Clothier, resident engineer for the district, confirms the opinion that the Truax Creek discovery is of more than ordinary importance. In particular, Mr. Clothier states that there is no doubt that the mineralization is related to an intrusion of diorite as is the case with the proved ore-bodies of economic importance on the Pioneer and Bralorne properties. Weight is thus given to the suggestion of an extension of the somewhat restricted area of this goldfield as heretofore defined. While the property is in the prospect stage, with very little effective prospecting or development—and snow conditions at the time of Mr. Clothier's examination prevented any detailed study of geological conditions—the occurrence as exposed has the ear-marks of an important deposit. There are said to be two converging veins, on one of which two cuts have been made within a distance of

about half a mile exposing widths of 5 ft. 10 in. and 8 ft. 6 in. over which samples were taken that assayed around $18 per ton. The other vein, upon which practically no work was done, shows free gold in the decomposed outcrop and arsenopyrite carrying high values is found in both veins. The property has been acquired by Truax Gold Mines, Ltd., a subsidiary organization of a company operating in the upper Cadwallader Creek area. The report of the resident engineer discloses the fact that development work carried on by Bridge River Exploration Company on the California property included the driving of a tunnel on the vein for a distance of 492 ft., with several cross-cuts to establish its width. According to the management these cross-cuts proved the vein to be from 10 ft. to 27 ft. wide. It is understood that a second drive is to be run at a further depth of 200 ft. on the vein and it would appear that a very considerable tonnage is in course of being blocked out. So far as is known, the values of this body of quartz have been found to be consistently low and it has yet to be proved that the deposit represents an economic proposition on a sufficiently large scale of operations.

Nelson.—The acquisition of the Venus-Juno-Athabasca properties by Noble Five Mines, Ltd., has been announced. It will be remembered that the Venus and Juno groups have been under operation by leasers, by whom effective work was done in opening up new possibilities for the development of ore reserves. Continuation of the ore-bodies beyond the limit of the old workings was proved by surface exposures and persistence of the Venus vein in depth is indicated by the results of samples taken along the floor of the 8th and lowest tunnel level of the mine. It has been pointed out also that the deeper development of the vein system might be advantageously undertaken from the Athabasca ground and on that account alone the amalgamation of the three properties in the negotiations that have been completed is regarded as affording good promise. Noble Five Mines, Ltd., has decided to enter the gold mining field rather than continue to wait for better prices for silver and lead. The company acquired the Noble Five and Surprise groups in the Slocan in 1928, after the former property had been extensively developed and equipped with a treatment plant by the late Hon. James Dunsmuir. Almost immediately after the purchase of the mine an ore-body was encountered in continuing an abandoned drive on the 18th cross-cut level, upon which great hopes were based. This discovery was on the Deadman vein and was described by the resident engineer as justifying anticipations of great importance, as the ore-shoot was opened up well within the heart of the mountain and in virgin ground. The expectations of profitable operations, however, were not fulfilled up to the time that the decline in metal prices forced the cessation of all work in the Slocan silver-lead district and the intensive development and construction work of the company was stopped. It is understood that a plan of vigorous development on the newly-acquired gold properties will be commenced immediately and if the results come up to expectations a mill will be erected. It is hoped that the properties may be brought into production on a basis of about 50 tons per day milling capacity before the end of the year. According to returns, past production from the three mines was valued at a total amount of over $700,000 from about 25,000 tons of ore treated. It is claimed that at that time the tailing losses were very heavy and that inadequate treatment was one of the main causes of the failure to operate successfully.

Sheep Creek.—Returns from the first month's operation of the new mill at the Reno are estimated at a value of $21,000. This is considered to be an entirely satisfactory performance, in view of the allowance that must be made for values locked up in the cyaniding circuit, of the fact that ore of a lower grade than the average was fed to the mill for the initial operations, and of the extremely unfavourable snow conditions that were bound to affect efficiency in all departments of the new equipment. The mill was tuned in gradually and has been brought up to a capacity of 75 tons per day, which will be increased shortly. A considerable increase in production is expected for the current month.

Lardeau.—The hydro-electric installation for the operation of the amalgamated properties on Lexington mountain that have been acquired by Meridian Mining Company has been completed and active development has been commenced. The construction work, which is to provide 1,000 horse power, has been tested under full pressure. The Eva, Cholla, Oyster-Criterion, and Lucky Boy groups that are included in this combine were responsible for a considerable

production from former operations, but on account of the low grade of the ore the individual working of the several properties was not found to be profitable. It is hoped that, with the excellent facilities that exist for cheap development work, a sufficient tonnage may be blocked out to warrant operations on a scale that will permit of low costs and it is understood that the company hopes to proceed will mill construction work later in the year.

Boundary.—Payment of a dividend to shareholders in Highland Lass, Ltd., was decided at a recent meeting of the directors at Kelowna. The Highland Lass mine, in the Beaverdell area, is one of the very few silver-lead properties that continue to be operated at a profit under the existing metal price conditions. The mine adjoins the Bell and is under the same management. During the past year 50 carloads of ore were shipped from the two properties, about one third of the production coming from the Highland Lass. One carload is reported to have had an average content of 433 oz. silver per ton. Recent developments in the mine are said to have opened up encouraging prospects of more continuous ore-shoots and higher values than were formerly representative of these deposits. No small credit attaches to the technical direction of these operations, the ore occurrence being affected by an intricate system of faulting.

Coast.—It is reported that the old Doratha Morton property, on Phillip's Arm, has been acquired by Hercules Mining Milling and Power Company and that further development is planned. This property was operated by an English company in 1898 and 1899 and a fair recovery is reported to have been made in a percolation cyanide plant. The work was stopped under conditions that have given rise to some speculation. At the time of suspension it was reported that cross-cuts from an adit tunnel had proved a continuous vein of considerable width and carrying uniformly good values in gold. Examination of the old workings discloses somewhat different conditions and it appears that the ore occurrence is represented by veins and lenses of quartz in a zone of shearing in granite rather than by a continuous reef about 100 ft. wide, as previously stated. The property is well situated near tide-water and offers certain attractions to development.

TORONTO

February 17.

Sudbury.—International Nickel is gradually getting rid of accumulated stock and increasing production, two calciners of the nickel-oxide department of the Port Colborne plant, closed since October, having resumed operations. Despite the fact that Falconbridge Nickel Mines recently increased its production operations, plans are under way for further expansion in the near future. The smelter capacity is now 520 tons per day, as compared with a former rate of 320 tons. The building for the new concentrator has now been completed, the installation of the equipment is making good progress, and within six weeks the concentrator will be ready for operation. Arrangements are being made for the handling of a larger tonnage of ore. The ore outlet system is being enlarged and underground workings extended into new ore-bodies. The Swayze gold area continues to attract many prospectors and much staking has been done. Upwards of 2,000 claims have been staked in the four townships, Swayze, Denyes, Halcrow, and Raney, and applications are coming in at the rate of about three a day. The Kenty gold mine in this area has installed mining equipment for supplying power and is putting down two shafts to a depth of 500 ft. McNeeley Matachewan Syndicate has secured a group of five claims to the west of the Kenty, where an extensive programme of development work is now being carried out. Diamond drilling on the property of the Kirkland-Hudson Bay Mines has met with encouraging results, a mineralized zone carrying high-grade gold having been encountered. The Shakespeare gold mine, a bullion producer twenty-five years ago, is being unwatered preparatory to resuming development. Many new companies are being organized and there will be great activity in this field during the coming season.

Porcupine.—Hollinger Consolidated during 1932 treated 1,754,863 tons of ore with a recovery of $11,723,074, as compared with 1,640,705 tons which yielded $10,528,864 in 1931. Income from other sources amounted to $147,165, a sharp contraction from $416,120 in 1931, while total costs and taxes amounted to $7,845,655 against $7,359,964, leaving a profit of $4,024,584 available for dividends. The total ore reserves are valued at $45,492,076, as compared with $46,241,688. In cross-cutting on the lower levels in prepara-

tion for the sinking of a new shaft many new veins have been encountered at depth, some of which, though narrow, carry rich ore. Dome Mines for the month of January reports bullion to the value of $364,879, as compared with $322,284 for December and $319,736 for January of last year. The mill is operating at the rate of 1,500 tons per day, with millheads averaging about $8 per ton. Good results are being obtained from development at the lower levels and a mineral zone recently entered in the greenstone on the 23rd level showed a width of 40 ft. On the 13th level there is a large quantity of high-grade ore in the rich pocket found some months ago. Coniaurum is completing arrangements to extend the scope of its operations and work will be started to sink the main shaft another 500 ft. to a depth of 3,000 ft. with the object of opening up the continuation of the vein system in four new levels. The development of the bottom levels has yielded ore in some sections well above mine average. The McIntyre is steadily maintaining its output. The recent completion of the modern milling plant has resulted in improved gold recovery and a decrease in mining costs.

Kirkland Lake.—The Lake Shore mill is maintaining a rate of bullion recovery in excess of $1,000,000 per month. An extension is being made to the mill for the treatment of tailings from the dump, a large part of which still contains good ore values. Improvement in milling practice has enabled the company to cut its tailing loss lately to around 60 cents per ton. A new ore-body 1,000 ft. north of the most northerly of the main ore-bodies has been intersected by diamond drilling, assays of drill cores indicating values of $12 per ton over 8 ft. width. Wright-Hargreaves has completed the sinking of its two shafts to the 4,000-ft. level, where they will be connected. At the 3,900-ft. level a high-grade vein entered number 4 shaft and this will be followed up to determine its extent and grade. The management has decided on increasing the mill capacity by an addition that will enable the treatment of between 1,200 and 1,500 tons a day, which it is expected will be in operation during the summer. An interim financial report of the Teck-Hughes for the first quarter of the financial year ending November 30 showed gross income of $1,495,340 and a surplus after all deductions available for dividends of $774,749. It has been decided to sink the shaft to a depth of 6,105 ft. A cross-cut at the 40th level is being run to connect the south shaft extension and the number 2 winze. The output is now in excess of $100,000 per week. The Sylvanite has cut a new vein of high-grade ore on the 2,750-ft. level in the unexplored section north of the shaft. The rise from the 3,000-ft. level on the new north vein is up 100 ft., with high-grade ore all the way. Recent development work has materially added to the mine's reserves. The Barry-Hollinger is preparing to deepen the shaft to the 2,500-ft. level and in the meantime the mill will be closed down until sufficient ore has been developed and blocked out to ensure permanent operation. At the Macassa about 500 ft. of ore has been opened up on the 2,475-ft. level showing an average grade of $11 per ton and the opening up of the 2,325-ft. horizon is also yielding good ore. The Kirkland Consolidated Mines is opening up good values on its first level and the shaft will be continued to a depth of 250 ft.

Other Ontario Goldfields.—The Howey gold mine, in the Patricia district, handled 328,700 tons of ore during 1932, producing bullion to the value of $1,121,000. Recent developments at the lower levels have indicated large tonnages of low-grade ore, in view of which the capacity of the mill will be increased from an average of 900 tons to approximately 1,400 tons per day. At the Central Patricia a mill of 75 tons capacity is under construction and the equipment is being shipped in. Development work is being resumed. The Ashley, in the Matachewan area, is treating about 75 tons per day, with millheads ranging from $18 to $20. Some important new discoveries have been made and a big programme of development work has been laid out. The Parkhill gold mine, in the Michipocoten area, is opening up high-grade ore on the 5th level. Since January 1 the mine has blocked out ore for about three months ahead of the mill requirements on the basis of an average of 100 tons a day. One ore-shoot, so far developed over 140 ft. in length, indicates about 6,000 tons of ore, with an average grade of $25 per ton. The Moss mine, in the Thunder Bay district, is overcoming difficulties with its mill, which is now treating ore averaging $9 to $10 per ton. Development on the lower workings shows that ore values are increasing at depth.

North-Western Quebec.—The Noranda continues to give its main attention to gold production. Recent improvements and

enlargements to the mill are running satisfactorily and it is stated that 4,700 tons of ore of all classes are being hoisted daily, while the ore reserves are being steadily increased. Work on the Chadbourne property of the company has revealed a large body of commercial ore carrying good gold values. The Siscoe during January produced gold to the value of $85,875, the mill treating 170 tons of ore daily and millheads averaging $15·34 per ton. A programme of development has been adopted under which no further sinking will be done at present, but the various levels from the 650-ft. to the 975-ft. horizon will be explored. An extension to the mill is being constructed which will give it a capacity of 225 tons. The new Hadsel mill of the Granada is running satisfactorily, reducing costs to 21 cents per ton, as compared with $1·16 with the old mill, the two mills having a total capacity of about 300 tons per day. Discoveries of high-grade ore have been made on the 675-ft., 1,075-ft., and 1,225-ft. levels. At the McWaters gold mine a diamond-drilling campaign has indicated high-grade gold values, a mining equipment is being installed, and active exploration will be undertaken as soon as possible. The Beattie has a 600-ton mill under construction, for which it has secured electric power, and it is expected to be ready for operation in April. Mine development is making good progress and values underground show some improvement over surface indications. The Pandora, in the Cadillac area, has encountered an important vein carrying high-grade ore on the 250-ft. level, which has been proved up for 500 ft. A diamond-drilling campaign will be undertaken. The Adanac is pushing development with satisfactory results, the three south-west veins, which produced good showings of ore carrying free gold, having been extended another 100 ft. to the east. The Sylvanite has acquired a group of claims on which good surface finds have been made and exploration will be carried on by diamond drilling. Several other established companies have acquired claims in this district and are preparing to start diamond drilling.

Manitoba.—The Manitoba Flin Flon, Ltd., which owns the Iron Horse group of claims adjoining the property of the Hudson Bay Mining and Smelting Co., is prospecting for gold and has met with a fair measure of success. There are strong leads of quartz and porphyry striking through the entire group and the contact of these zones with the greenstone is an encouraging indication. Vanson Gold Mines, whose property adjoins the San Antonia mines, expects to have its mill installed and in operation by March 1. A shaft has been sunk 55 ft. and will be continued to a depth of 125 ft., where driving will be started. An extensive programme of development has been arranged for the property of God's Lake Gold Mines, in the God's Lake section of Northern Manitoba. High-grade samples were obtained from surface work last year and diamond drilling and exploration will be actively pushed early in the season. The Oro Grande has been working with a little test mill, with results which have encouraged the management to decide on the construction of a 50-ton mill, and a complete mining plant will be taken into the property without delay.

BRISBANE

January 24.

Mount Isa.—In underground work at Mount Isa during December the seven glory-holes in the Black Star section were all worked without interruption and the stripping of the overburden was continued, the usual amount of development work being also carried out. This was likewise the case in the Black Rock section, where jig tailings for filling were at the same time scraped into the glory-hole. Inclined cut-and-fill stoping was carried out continuously at No. 2 level. In the No. 3 level No. 3 stope is being widened out to the limits of the ore and the fill rises have been commenced. In the Rio Grande section stoping was completed in the middle-lode stope at the No. 1 level, while at the No. 4 level ore was drawn as required from the hanging-wall stope at the south end. The drawing of ore from the foot-wall and hanging-wall stopes was completed. The unfortunate position in which the Mount Isa enterprise is placed through the extremely low metal market values still prevailing was explained lately in an interview given in Brisbane by Mr. J. P. B. Webster. The Mount Isa mine has now reached the 5,000 tons a month capacity aimed at as the first stage of production and an even greater output could be attained if conditions warranted expansion. Mr. Webster asserts that of the total cost of production 40% is accounted for by direct transport charges, of which more than 28% represents the cost of haulage on the Queens-

land railways. He has placed the position before the State Premier (Mr. W. F. Smith), but as yet nothing is known as to the outcome of his interview.

Mount Coolon Goldfield.—At the Mount Coolon goldfield, Central Queensland, the British company, Mount Coolon Gold Mines, N.L., after a satisfactory trial run on the new milling plant has got the machinery into regular work and is keeping it up to its capacity of between 1,000 and 1,200 tons a week, cleaning up each fortnight. In the last four-weekly period a quantity of 3,716 tons yielded 2,839 oz. of gold, worth £12,061, and 1,135 oz. of silver, valued at about £57. At the mine the main shaft and two winzes are being sunk below the 300-ft. level. An adjoining mine, owned by Mount Coolon West, N.L., is on the eve of making a start. This company holds three leases under option to purchase, including a well-known mine called the Dig Again and the Mount Coolon Extended. Portions of the machinery required for testing the holdings have arrived on the ground and a number of men are employed in preparatory work.

Mount Morgan.—The Mount Morgan Company has now settled down to regular and systematic work. The chief operations are at present centred in what is now called " the quarry," but was formerly known as a part of the open-cut operations. The well-known Linda level, which will eventually be the ore haulage road, is being cleaned out so as to connect it with the main shaft. The No. 5 north-west level is being pushed on to No. 14 shaft preparatory to utilizing the level as a well-hole for overburden. In the concentrating mill an increased tonnage capacity has been secured by getting the second grinding mill and its attendant machinery into commission. It is expected that the plant will now be able to treat 200 tons of material a day.

New Goldfields.—The population on the new Cracow goldfield, Central Queensland, is now settling down to solid work. The speculative element, which was really retarding genuine efforts to develop the field, has now left it. The township allotments were sold early in December and the town has quite a number of buildings. Although the population has decreased, those remaining seem to be fully employed. Cracow's prospects, like those of most new mining fields, have been much damaged by a few persons competing against one another by taking ridiculous options, half of which probably would never mature. One result is that a considerable number of good auriferous areas are now available for genuine prospecting for half the sums originally asked for them. Lolworth Creek, in the Charters Towers district, where operations have been delayed for two or three months for want of water, has now had a good fall of rain, which has filled the new weir and enabled the mill that was ready for work to start on the considerable quantity of ore that was ready for crushing. The principal mine on the field, held by Lolworth Options, Ltd., is showing promising indications, including good assay results. Several other smaller holdings are already being worked and it seems likely that a prosperous, though small, auriferous field will evolve.

Last Year's Mineral Output.—Statistics are not yet available showing the output of gold and other minerals of the different Australian States for the year 1932, but from what figures have been published it is evident that there will be at least a substantial increase in the gold yield compared with the return for 1931. This result has been brought about by increased activity in prospecting, the high price ruling for gold, and the Federal gold bonus that was paid up to the end of September. The largest increase in gold yield will be found to be in Western Australia. As far as Queensland is concerned, returns for eleven months of the year show a very substantial improvement on those of the like period of 1931. For other minerals in this State the returns for nine months of the past year show a total value of £649,972, an increase of £414,568. Thanks to Mount Isa, with its big output of lead and silver, this result was achieved in the face of the continued low price of metals. The principal State coal mine—that on the Bowen field, North Queensland—continues to have a falling output, notwithstanding the large supplies sent regularly to Mount Isa. The output of this mine for the financial year ended June 30 last was 105,226 tons, against 133,558 tons in the previous year. The two smaller State collieries—those at the Styx River and Mount Mulligan—showed slightly improved returns. All endeavours to open up a coal trade with the Eastern markets have failed.

Platinum in Papua.—A rich discovery of platinum associated with gold is reported to have been made in the Papuan jungle some 120 miles from Samarai. The discovery

was made by Mr. M. H. Cutlack, of Sydney, who recently passed through Brisbane on his return from Papua after leading in that territory a mining expedition sent out by North-West New Guinea Goldfields, Ltd. A geological mining expert (Mr. N. E. Baker), who accompanied Mr. Cutlack back to Australia, said he was convinced the find held promise of being one of the most important mining discoveries made in New Guinea. Mr. Cutlack pegged out a large area for his company.

The Granites, Central Australia.—The manager of Chapman's Gold Mines, Ltd., reporting under date January 11, says that on the company's Burdekin Duck area at The Granites development work is now being carried out and that so far the prospects have been satisfactory. Two crushings had been put through the small battery on the field. The first, consisting of 10 tons, he states, gave a yield of approximately 52 oz. of amalgam, which returned 16½ oz. of retorted gold, exclusive of gold left on the plates, while the second parcel (quantity of stone crushed not stated) returned 213 oz. of amalgam, which it was anticipated would return 106 oz. of gold. The gold won is said to be paying expenses and the board has decided to develop the Burdekin Duck, Ajax, and Bunker's Hill properties.

Mount Lyell.—During the quarter ended December 31 the Mount Lyell Mining and Railway Company, Ltd. (Tasmania), treated 96,965 tons of ore, which produced 9,972 tons of concentrates. North Mount Lyell ore smelted in the same period totalled 2,884 tons and 8,128 tons of concentrates were smelted. The quantity of blister copper produced was 2,095 tons and its contents were 2,075 tons of copper, 30,633 oz. of silver, and 972 oz. of gold. The furnace ran 52 days and the cathode copper produced was 2,608 tons.

Tropical Hygiene.—The British Red Cross Society is to hold a course of seven lectures and demonstrations on tropical hygiene, on Mondays, Wednesdays, and Fridays, commencing on Friday, April 1, at 9, Chesham Street, S.W. 1, at 5.30 p.m. The course will cover such questions as food, clothing, and medical and sanitary precautions necessary for health in hot countries. Fees for the course are 5s. for members of the society and 7s. 6d. for non-members.

PERSONAL

John A. Agnew has been appointed chairman of the boards of the Consolidated Gold Fields of South Africa, Ltd., and the New Consolidated Gold Fields of South Africa, Ltd.

Claude Allen is returning to South America.

Cyril W. F. Bond has left for the Gold Coast.

H. O. Crighton is returning from the Gold Coast.

W. R. Feldtmann is returning from South-West Africa.

Richard Harvey has left for the Gold Coast.

W. Hope Henderson has returned from California.

Sir Albert E. Kitson has joined the board of Taquah and Abosso Mines, Ltd.

Malcolm Maclaren is on a visit to the Gold Coast.

Percy E. Marmion has returned from Burma.

W. H. Rundall is returning from South America.

J. Sanderson is returning from Malaya on leave.

W. J. Shephard has left for the Gold Coast.

G. Gordon Thomas has been appointed manager of the Elandshoogte Propriety, Ltd., Eastern Transvaal.

W. H. Trewartha-James is returning from Western Australia.

S. J. Truscott has left for Toronto.

A. H. E. Turner is returning to the Gold Coast.

H. B. Wall has left for Kenya.

F. R. Whitney has left for Brazil.

James Miners Holman, head of the firm of Holman Bros., Ltd., of Camborne, died on February 27 at the age of 75.

TRADE PARAGRAPHS

Bureau of Information on Nickel of the Mond Nickel Co., Ltd., of Thames House, Millbank, London, S.W. 1, in their *Nickel Bulletin* for January have an article on the subject of certain nickel alloy steels for parts of rock-drills and other pneumatic tools.

Ruston and Hornsby, Ltd., of Lincoln, have received instructions to build eight auxiliary generating sets of 100 k.w. each, required for liners now under construction at Belfast. The engines will be 5-cylinder vertical units of the airless injection type.

R. S. Patrick, of Duluth, Minnesota, U.S.A., issues various pamphlets emphasizing the importance of diamond core drilling in the rapid exploration of new fields as well as in the ready determination of existing ore-bodies. These are particularly illustrated by results obtained in the Kirkland Lake and other areas in Canada, specific examples being cited such as the Ashley mine, the Hollinger mine, and the Island Lake option.

Drysdale and Co., Ltd., of Yoker, Glasgow, publish a catalogue describing their Wee-Mac self-priming centrifugal pump suitable for a variety of light duties such as sump drainage, boiler feed, and water circulation in process work. The pump is made in a variety of sizes suitable for capacities ranging from 120 to 1,200 gallons per hour at various heads. It is also made for various drives—electric motor, belt, and petrol engine, and in portable forms.

Sir Isaac Pitman and Sons, Ltd., of Parker Street, Kingsway, W.C. 2, issue parts 10 and 11

of their *Engineering Educator*. Part 10 contains the continuation of the subject of pumps construction and maintenance and opens the subject of structural steelwork, while part 11 contains the commencement of the chapter on metallurgy for engineers and this concludes volume 1 of the series, in which an index to all the previous parts is included.

Sulzer Bros. (London), Ltd., of 31, Bedford Square, London, W.C. 1 (Head Office : Winterthur, Switzerland), announce that they have entered into an agreement with **Sir W. G. Armstrong Whitworth and Co., Ltd.,** of Newcastle-on-Tyne, to manufacture certain of their specialties at the latter's Scotswood works. The supply of machinery manufactured in Switzerland will still be available as hitherto but by this arrangement the firm will be in a position to supply British-built plant when desired.

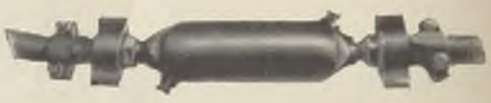
Ransomes and Rapier, Ltd., of Ipswich, have published a new illustrated brochure describing their type 421 ½ cu. yd. excavator. In addition to photographs showing the machine equipped as a shovel, dragline, back trencher, and skimmer scoop, the brochure has one or two pictures taken at convenient angles to show the component parts. The excavator is made for Diesel engine, petrol-paraffin, or electric drive. In the first case McLaren-Benz engines of 37 b.h.p. at 1,000 r.p.m. are fitted and in the second Dorman engines of the same rating.

Worthington-Simpson, Ltd., of Newark-on-Trent, have received the complete contract for the supply of main oil-line pumps for the Iraq pipe-line, referred to elsewhere in this issue under the heading of G. D. Peters and Co. The order comprises 45 horizontal, duplex, double-acting, outside-packed, plunger-forged, fluid-end pumps, 6¾ in. by 24 in., with single-reduction helical gear and totally enclosed to prevent ingress of sand. The pumps will transport oil a total distance of 1,200 miles and will be driven by 500 h.p. Diesel engines by various makers. The order is described as being the largest by far of any so far placed in this country for pumping equipment.

Demag, A.G., of Duisberg, Germany, in their *Demag News* for January (just available) have an article on wagon traffic system of a modern pit-head plant, another on the operation and supervision of rubber belt-conveyers in the mine, and a third on the economic working of a sub-level section of seam by means of Demag scraper conveyers. The February issue contains a description of a new small-size excavator made in the conventional universal form and fully convertible. The bucket capacity is not stated, but this is probably of the order of ¾ cu. yd., since the motive power is a 60 h.p. two-stroke Diesel engine, a petrol engine or electric drive being offered as alternatives.

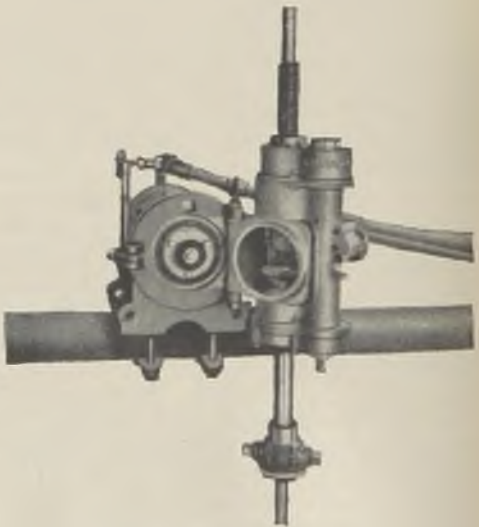
Patent Lightning Crusher Co., Ltd., of 14a, Rosebery Avenue, London, E.C. 1, issue a new publication on "Lightning" granulators and pulverizers. This, after discussing the general principles of granulators and pulverizers, continues to describe their own machine, which is of the swinging-hammer type and is suitable for breaking down moderately hard material such as limestone from 2½ in. cube to ¾ in. cube at the rate of about 5 tons per hour for a power consumption of between 8 and 10 b.h.p. A larger unit will handle material 5 in. and reduce it to ¾ in. at the rate of 15 tons per hour for a power consumption of 18 to 20 b.h.p. The firm have a fully equipped testing plant, where work on samples is carried out free of charge.

Climax Rock Drill and Engineering Works, Ltd., of 4, Broad Street Place, London, E.C. 2, announce particulars of their air-line lubricator, the shape of which, as may be seen from the illustration, ensures that it will not cause entanglement with external objects. It may be also used in any position from horizontal to vertical



indifferently and in all cases the amount of oil delivered will be invariable and regular in relation to the volume of air passing through it. It delivers the oil as the result of pulsations in the air flow caused by the movement of the piston in the rock-drill, but the flow is also controlled by capillary action between the plates, that are built into the lubricator barrel. It is also so arranged that no attention need be paid to the direction of flow of air through the lubricator, either way being equally satisfactory. The following are principal dimensions : Overall length, 12 in. ; outside diameter, 3½ in. ; air inlet and outlet tapped 1 in. gas ; weight, 14 lb. ; capacity, 1 pint.

Austin Hoy and Co., Ltd., of Bush House, London, W.C. 2, are distributing leaflets describing the Longyear prospector, which is an extra-light core-drill, the production of **Canadian Longyear, Ltd.,** of Northbay, Ontario, this being specially designed for the economic drilling of holes to a moderate depth and is adapted for air, petrol, or electric motive power. It will drill horizontal cross-cut holes in a drive 5 ft. wide and vertical holes in any ordinary mine opening. For surface work the petrol model with light tubular frame is adapted for light exploration. In the accompanying photograph the air-operated machine is shown with the head open. For compressed-air drive the drill is equipped with a standard 4-cylinder reciprocating air motor, for petrol drive with a 2-cylinder 4-cycle engine rated at 5 b.h.p., and for electric drive it is made to conform to available current. The



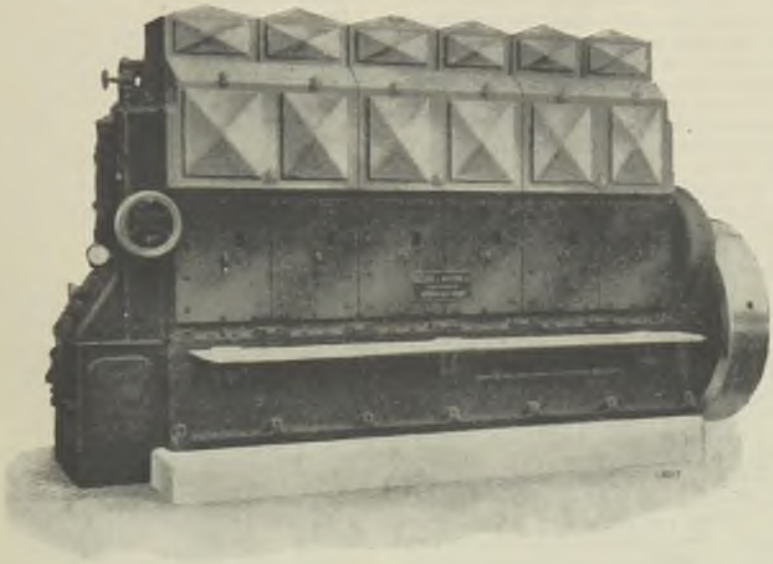
LONGYEAR AIR PROSPECTOR.

normal depth capacity is 250 ft. with standard (EX) fittings or with "prospector" size fittings (11/16 in. core). The drill being of 82–84% Canadian material and workmanship qualifies for the British preferential tariff on entering any of the British Dominions.

Mining and Industrial Equipment, Ltd., of 11, Southampton Row, London, W.C. 1, report having received the following orders: For England: One 7 ft. by 60 in. Hardinge conical ball-mill for coal, one No. 50 Raymond Impax pulverizer for gypsum, two No. 70 Raymond Impax pulverizers for bituminous coal, one No. 0000 Raymond pulverizer for soap powder, two 4 ft. by 8 ft., type 400, Hum-mer electric screens for billy coal, two 4 ft. by 8 ft., type 400, Hum-mer electric screens for coal, and one 3 in. X Grit pump for flue-dust slurry. For Wales: Four 10 ft. by 72 in. Hardinge conical ball-mills for Welsh anthracite, and one No. 0000 Raymond pulverizer for unnamed duty. For India: One 8 ft. by 48 in. Hardinge conical ball-mill for crude copper ore. For South America: One 2 in. X grip pump to deliver 100 U.S. gls. per min. containing solids. For Russia: Three 4 roller Raymond mills for clay.

Curchin and Watson, of Bevis Marks House, London, E.C. 3, have issued for **Werf Conrad,** of Haarlem, Holland, a booklet on gold dredging which describes their products. This is a well-prepared and fully-illustrated publication covering some 45 pages and, after dealing briefly with the history of gold dredging, it comes to the discussion of modern practice, which it opens with a section devoted to prospecting. This affords an opportunity of describing the essential parts and the manipulation of the Banka drill. Various dredges are then described and illustrated, as operating in all parts of the world. The subsequent section deals with dredge parts, notably buckets, bucket pins, top and bottom tumblers, digging ladders, ladder rollers, gearing, gantries, revolving screens (separator or trommel), the distributor, gold-saving tables or sluice-boxes, jigs, the hull of the dredge, the stacker or elevator for tailings, the mooring winch, the ladder-hoist winch, pumps, clay-digging, electric lighting, and operating power. The section concludes with some details of the capacity of dredges and there is a short note on hydraulic mining, which points out that the equipment required for this is also made by the firm. The booklet is completed with a form of questionnaire suitable for making known the requirements of a particular dredging proposition.

Belliss and Morcom, Ltd., of Ledsam Street Works, Birmingham, recently afforded us an opportunity of visiting their works, where we saw in various stages of manufacture vertical oil engines, steam engines, reciprocating and rotary air-compressors, and turbines. Other manufactures include condensing plant, centrifugal pumps, paraffin engines, and pneumatic hose. The vertical air-compressors are made both for steam engine and electric drive. In the former case the compressor is frequently built on top of the steam engine cylinders, while in the latter case the bedplate is made sufficiently large to allow of the mounting of an electric motor alongside. Rotary blowers and compressors may be for steam-turbine or electric-motor drive. A feature of the works is that examples of every type of prime mover manufactured are available for employment in generating their own power requirements. Thus there are in operation or standing by two kinds of vertical steam engine with auxiliary condensing plant, a steam turbine, and air and airless injection vertical Diesel engines. Boiler-house plant for supplying steam is of the most up-to-date kind and includes superheating equipment and the usual control. Among oil engines particular mention may be made of the compressorless Diesel of the type that was shown in operation at the British Industries Fair. This is a 6-cylinder vertical four-stroke engine, developing 200 b.h.p. at 600 r.p.m. and, as may be seen from the accompanying illustration, is totally enclosed.



Belliss and Morcom Airless-Injection Diesel Oil Engine.

Outstanding features of this engine are the following: Access doors are of ample dimensions. The liners are of pearlitic cast iron of the "wet" type and are removable. The water jackets are provided with inspection and cleaning doors. The cylinder heads and pistons are also of pearlitic cast iron. The gudgeon pins are of the restricted floating type. The whole of the valve-operating gear is forced lubricated, as is also the camshaft, which is gear driven. The governing is powerful and sensitive, a permanent speed variation of only 3½ to 4% resulting when the load is suddenly thrown off the engine. A single control handle operates the starting gear and is used for speed control. The wheel operates in correct sequence the starting-air control valves and the fuel pumps in the safest possible way—i.e., it is impossible for the starting-air supply and the fuel oil to enter the cylinder at the same time. The fuel system is of the "B and M"-Bosch type and has been isolated from that of the lubrication. The water outlet from each cylinder is visible and the exhaust pipe manifold is water cooled. For starting air is drawn from a receiver which is charged by a small independent air-compressor. These engines are made in sizes ranging from one to eight cylinders and 33 to 266 b.h.p. Another range of engines at 375 r.p.m. develop from 150 to 880 b.h.p. in sizes of from two to eight cylinders.

G. D. Peters and Co., Ltd., of Windsor Works, Slough, furnish the following information on the requirements of the Iraq pipe-line. There are, in fact, two distinct lines—one extending from Kirkuk, which is situated 150 miles north of Baghdad, to Tripoli on the eastern shore of the Mediterranean, a distance of 531 miles, and the other following a similar course from Kirkuk for approximately 180 miles and then branching off in a south-westerly direction through Transjordania and Palestine to Haifa, a total length of 618 miles. Two rivers have to be crossed by both lines, the Tigris and the Euphrates. The pipe to be used has an internal diameter of 12 in. with walls ⅜ in. thick and consists of seamless steel tube in lengths of 40 to 50 ft. All the joints are to be arc welded. The pipes are "belled" out for approximately 4 in. at each end in order that an internal "chill" ring 12¾ in. external diameter may be inserted, each end of the pipe proper being chamfered so that when brought together a "vee" is produced which, in addition to facilitating welding, permits of sufficient penetration of the arc in the ring to ensure a sound joint. Two types of electric welders are to be used, the smaller having a capacity of 300 amps. and the larger 400 amps., the firm having obtained orders for nine of the larger and five of the smaller machines. Those supplied are of the "S" type embodying a drooping-characteristic generator, having an open-circuit voltage of 60° drooping to 23/30 on load with the metallic arc and from 60 to 35/40 with the carbon arc. In view of the very severe weather conditions both types have been designed for a temperature rise of only 30° C. and on test the ultimate rise was well under this figure. The generators are coupled to 6-cylinder petrol engines of 58 h.p. in the case of the 400 amp. and 41 h.p. in the case of the 300 amp., both types running at 1,450 r.p.m. Special radiators have had to be fitted to these engines in order to comply with the requirement that the cooling water should be kept below 180° F., a considerable problem since the sun temperature of the desert is as high as this figure.

BRITISH INDUSTRIES FAIR

The British Industries Fair was held as usual simultaneously in London and Birmingham from February 20 to March 3 and following is a description of some of the exhibits of more particular interest to mining men:

Evershed and Vignoles, Ltd., of Chiswick, London, W. 4, in addition to Megger testing sets, were exhibiting the Midworth distant control.

N. Greening and Sons, Ltd., of Britannia Works, Warrington, were showing woven wire and perforated metals in all forms suitable for screens and conveyer belts.

Cooke, Troughton, and Simms, Ltd., of 15–17, Broadway, Westminster, London, S.W. 1, were exhibiting a Vickers' projection microscope designed for metallurgical research.

Dunlop Rubber Co., Ltd., of Cambridge Street, Manchester, were showing belting for all purposes and pneumatic hose, among a variety of industrial rubber products.

Tubes, Ltd., of Aston, Birmingham, were exhibiting cold-drawn weldless steel tubes ranging from ¼ in. to 14½ in. bore, also tubes in Resistco stainless and other special steels.

Dermatine Co., Ltd., of 93 and 95, Neate Street, London, S.E. 5, were showing belting for driving and conveying, valves for service pumps, pneumatic hose, and suchlike.

George Ellison, Ltd., of Birmingham, were exhibiting switchgear of all kinds, circuit breakers, motor starters and controllers, and particularly flameproof mining control gear.

Cambridge Instrument Co., Ltd., of 45 Grosvenor Place, London, S.W. 1, had a representative selection of their measuring instruments for temperature, CO_2, pressure, and other control.

Ashmore, Benson, Pease, and Co., Ltd., of Parkfield Works, Stockton-on-Tees, were showing a model of a water-gas plant and examples of other of their products of interest to the power-generation engineer.

Crompton Parkinson, Ltd., of Bush House, London, W.C. 2, were exhibiting electric motors and control gear of many types, including generating plant, rotary converters, switchgear, and instruments.

Cassel Cyanide Co., Ltd., of Oldbury, near Birmingham, were demonstrating the use of cyanide for case hardening and heat treatment purposes, colour tempering of steel, and the annealing of non-ferrous metals.

Laurence Scott and Electromotors, Ltd., of Norwich and Manchester, were showing totally enclosed d.c. and a.c. motors. "Burke-Scott" arc welders, control gear, and flameproof motors; also variable speed motors.

Mavor and Coulson, Ltd., of 47, Broad Street, Glasgow, at the outdoor exhibit were demonstrating the Joy loader suitable for a variety of material handling. This machine was described in the MAGAZINE for May, 1932.

Huntington Heberlein, Ltd., of 47–51, King William Street, London, E.C. 4, were represented in the outdoor exhibition, where they were showing jigging screens and also the H.H. vibrating screen for handling sand, gravel, and ores.

F. Braby and Co., Ltd., of 352–364, Euston Road, London, N.W. 1, had on their stand a representative display of sheet-metal and woven-wire work. Their metal work included tanks and drums, air receivers, ventilators, and ducts.

Bureau of Information on Nickel of the Mond Nickel Co., Ltd., of Thames House, Millbank, London, S.W. 1, were showing by means of diorama examples of the uses of nickel and nickel alloys in engineering, chemical, and other industries.

W. C. Holmes and Co., Ltd., of Whitestone Ironworks, Turnbridge, Huddersfield, illustrated by means of models and photographs their chemical engineering plant, notably Holmes-Connersville meters, exhausters, boosters, and blowers.

P. B. Sillimanite Co., Ltd., of 791, Salisbury House, London, E.C. 2, were showing examples of their bricks. blocks, ties, and electrical insulation parts made of sillimanite ; also refractory patching and setting cements, furnace linings, and pyrometer tubes.

John Bedford and Sons, Ltd., of Lion Works, Mowbray Street, Sheffield, occupied a stand on which was a representative display of their steel products, such as high-speed alloy and tool steels and fabrications thereof, including shovels and spades.

Babcock and Wilcox, Ltd., of 32, Farringdon Street, London, E.C. 4, occupied a large stand on which they were demonstrating their boiler-house plant. This included pulverized fuel equipment, water-tube boilers, Bailey furnace walls, valves, and accessories.

British Oxygen, Co., Ltd., of Angel Road, Edmonton, London, N. 18, on a stand devoted to oxy-acetylene welding and cutting equipment were making a special feature of metal-spraying plant for the anti-corrosion coating of surfaces with zinc, copper, and other metals.

A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne, were showing flame-proof air-break switch and transformer units suitable for controlling portable coal drills and coal-face lighting equipment. Examples of suitable lighting equipment for underground were also included.

Harland Engineering Co., Ltd., of B.E.P. Works, Alloa, Scotland, were exhibiting high- and low-tension switchgear for alternating and direct current, including oil circuit breakers, current transformers, switches, contactors, distribution boards, and metal-clad switchgear.

Robert Hudson, Ltd., of 38*a*, Bond Street, Leeds, occupied a stand and were also represented in the outdoor exhibition. On the stand they were showing tipping wagons in several sizes and gauges. On the outdoor stand was an automatic double side-tipping wagon of 4 ft. 8½ in. rail gauge.

J. H. Holmes and Co., Ltd., of Hebburn-on-Tyne, were joint occupants of a stand with A. Reyrolle and Co., Ltd., on which they were showing representative examples of a.c. and d.c. motors and generators, especially conveyer motors and also electric welding equipment and distribution gear.

Thos. Firth and John Brown, Ltd., of Atlas and Norfolk Works, Sheffield, occupied two large stands in a prominent position, on which they were showing Firth staybrite steel in all its many fabricated applications. Other features of their stand were tools and high-speed steels including the Insto saw.

Wild-Barfield Electric Furnaces, Ltd., of Elecfurn Works, North Road, Holloway, London, N. 7, were showing a box type of furnace suitable for reheating up to 1,100° C, time and temperature control equipment, a new type of furnace with forced air circulation, and a range of Telcon electric resistance materials.

United Steel Companies, Ltd., of 17, Westbourne Road, Sheffield, were exhibiting a variety of steel products, notably pit props and arches including a new design of collapsible pit prop, of which a description will be given in a forthcoming issue. Steel in the form of strip and wire, castings, and forgings, and tool steels was included in the exhibit.

Motor Rail, Ltd., of Simplex Works, Elstow Road, Bedford, occupied a stand and were also demonstrating Diesel locomotives in the outside exhibit. Diesel locomotives are made in sizes ranging from 12/16 h.p. to 65/85 h.p., the tractive effort on the level ranging from 1,250 lb. to 5,729 lb. The firm are also makers of petrol locomotives in a range from 12 to 50 h.p.

Hunslet Engine Co., Ltd., of Leeds, were joint occupants of a stand with **Robert Hudson, Ltd.,** and were also represented in the outdoor exhibit. They were making a feature of their 150 h.p. Diesel locomotive, which has undergone severe trials on the L.M.S. railway and is fitted with patent automatic chain gear and clutch. They had in actual operation a small (35 h.p.) Diesel locomotive.

Bromford Tube Co., Ltd., of Rocky Lane, Aston, Birmingham, occupied a stand and were also represented in the outside exhibition. They were showing tubing of various lengths and sizes and in particular an example of the type which has been ordered for the Iraq pipe-line referred to at some length elsewhere in this issue under the heading of G. D. Peters and Co., Ltd.

Canadian Government Exhibition Commission, of Canadian Building, Blackburn Road, West Hampstead, N.W. 6, occupied a large stand on which were represented the Canadian National Railways, the Canadian Pacific Railway, and the Department of Trade and Commerce. The exhibit included some specimens of Canadian mineral products, notable among which were two examples of radium-bearing ore.

G. D. Peters and Co., Ltd., of Windsor Works, Slough, were demonstrating electric arc welding and had on their stand examples of two of their portable units. They were also showing photographs of equipment supplied to the Iraq Petroleum Co., Ltd., for the construction of the pipe-line connecting the oilfields with the sea. Some notes on this pipe-line have been supplied by the firm, and are referred to elsewhere in this issue.

Ruston-Bucyrus, Ltd., of Lincoln, were occupants of a stand on which they were showing in association with **Ruston and Hornsby, Ltd.,** a Diesel locomotive such as has been described in these columns. In the outside exhibit they were showing in operation a 21B Diesel excavator of ¾-cu. yd. bucket capacity fitted as a dragline and operated by a Ruston 4-cylinder 70 h.p. engine, a product that is already familiar to readers.

Broom and Wade, Ltd., of High Wycombe, occupied a large stand on which they were showing air-compressors and pneumatic tools. Two examples of their portable compressors were shown, while another was in operation in the outdoor exhibit. They were also showing a rotary air-compressor suitable for small pressures up to 40 lb. per sq. in. A feature of their portable compressor is that the petrol engine power unit is of their own manufacture.

Alfred Herbert, Ltd., of Coventry, besides exhibiting Atritor pulverizing equipment for coal firing were making a feature of Modave patent dust and sulphur removal plant. They were also giving some space to the demonstration of the principle of the Boby precipitation plant in association with **William Boby and Co., Ltd.,** of 62–64, Brook Street, London, W. 1. Further attention to both these developments will be given in a forthcoming issue.

Thomas Locker and Co., Ltd., of Warrington, were showing woven-wire and perforated-metal screens for all purposes, including the "Trayco" all-electric vibrating screen and the vibrating feeder and conveyer in operation. These products were described in the MAGAZINE for April, 1930. Two examples of the latter were shown—a small model capable of handling up to 1,000 lb. per hour and a heavy-duty model suitable for 300 tons per hour.

G. A. Harvey and Co. (London), Ltd., of Greenwich Metal Works, London, S.E. 7, were displaying a variety of their sheet-metal products and woven-wire work. Attention is particularly directed to a new type of woven wire specially suitable for vibrating screens made of a material which is hard and tough and not brittle. Among the range of metals perforated or woven by the firm are steel, copper, brass, bronze, nickel, duralumin, and stainless steel.

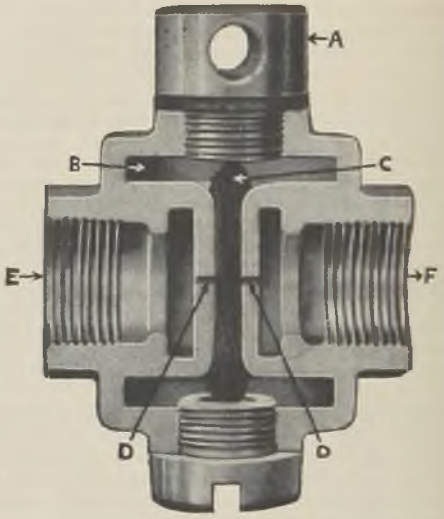
Stewarts and Lloyds, Ltd., of Birmingham, occupied two large stands and were also represented in the outdoor exhibit. They were showing screwed and socketed wrought iron and steel tubes and fittings, boiler tubes, bitumen-lined tubes, coupling coils, pit props, etc. A special feature was made of a section of the tube which has been ordered for the Iraq pipe-line and is referred to at some length under the heading of G. D. Peters and Co., Ltd., elsewhere in this issue.

Murex Welding Processes, Ltd., of Ferry Lane Works, Forest Road, Walthamstow, London, E. 17. were showing arc-welding equipment and were making a particular feature of several new types of electrodes. One such is known as "Fastx" and has only recently been placed on the market to meet the demand for high-speed welding. Another electrode is known as "Hardx" and is manufactured for the hard surfacing of metals. The Brinell hardness of the weld metal deposited is given as 640 to 670, no quenching or other treatment being required to obtain this high figure.

Imperial Chemical Industries, Ltd., of Imperial Chemical House, Millbank, London, S.W. 1, were represented on several stands by their various subsidiary companies. Notable among these were the Mond Nickel Co. (referred to elsewhere), Cassel Cyanide Co. (referred to elsewhere), and I.C.I. Metals, Ltd., of Birmingham. The latter were showing non-ferrous metals and alloys, especially copper and brass in the form of plates, sheets, strips, tubes, rods, wire, sheathing, roofing, etc. On another stand they were showing their degreasing plant, which has already been described in these columns.

British Arca Regulators, Ltd., of Windsor House, Victoria Street, London, S.W. 1, occupied a stand in association with Belliss and Morcom, on which they were displaying sectionalized elements of control equipment for a wide variety of purposes. Among these may be mentioned the automatic control of steam desuperheating, automatic temperature regulators, high-pressure and low-pressure steam regulators, humidity regulators, gas governors, and traffic regulators. All these accessories are generally operated hydraulically, although there are cases when oil may be used as the medium in place of water. Detailed particulars of some examples of their application will be contained in forthcoming issues.

C. C. Wakefield and Co., Ltd., of Wakefield House, London, E.C. 2, on a stand devoted to lubricating oil and equipment for using it, were demonstrating their "Ayrlyne" lubricator suitable for all types of compressed-air machinery. The essential features of this are illustrated in the accompanying photograph to which the following



WAKEFIELD'S "AYRLYNE" LUBRICATOR.

is the key: A—filler tap. B—oil reservoir. C—worsted plug. D—oil outlets. E—air inlet. F—air outlet. The lubricator can be fitted direct to the machine or in the air pipe-line, whichever is most convenient. It is immaterial which end is connected to the air inlet. The booklet published by the firm gives full instructions for the proper use of this accessory.

Belliss and Morcom, Ltd., of Ledsam Street Works, Birmingham, occupied a large stand in the centre of the Fair on which they had a running exhibit of their 6-cylinder compressorless Diesel engine, which is further described elsewhere in this issue. Another running exhibit was of a gas compressor designed for use in connexion with experiments which are being widely carried out on the use of coal gas in the place of petrol or fuel oil in internal combustion engines. These take gas at 5,000 lb. per square in. pressure from a filling station consisting of suitable reservoir bottles. From this filling station demonstration vehicles at the Fair were obtaining their fuel. Other exhibits included a small compound steam engine, a 2-stage vertical air-compressor, and a small turbine.

English Electric Co., Ltd., of Queen's House, Kingsway, London, W.C. 2, were showing a 6-cylinder vertical Diesel engine of the mechanical-injection cold-starting type. The Rugby works of the company has produced oil engines for more than 25 years and Willans and Robinson the former proprietors were one of the pioneers of its development in this country. The engine exhibited was one of 300 h.p. at 600 r.p.m. The engine is known as the " K " type and has been standardized in units having any number of cylinders from 3 to 8, each cylinder giving an output of 50 h.p. at the normal speed, the range in output being thus 150–400 h.p. A similar range of engines known as the type " L " is also manufactured with output ranging from 375–1,000 h.p. On this stand also were several other examples of their products, including electric motors, control gear, induction regulators, and distribution transformers.

Sir W. G. Armstrong, Whitworth, and Co. (Engineers), Ltd., of Thames House, London, S.W. 1, were part occupants of a stand with **Shell-Mex and B.P., Ltd.,** of Shell-Mex House, Kingsway, London, W.C. 2, on which they were demonstrating a cylindrical oil-fired tilting furnace suitable for a variety of metal-melting purposes. Of greater interest to mining men, however, was their demonstration of Diesel-electric transport. This was provided in the shape of an express train running daily between London and Birmingham and the following figures will serve to illustrate the performance obtained: Distance, 113 miles; weight, 47 tons; highest speed, 70 m.p.h.; total fuel consumption, 20 galls; cost of fuel per gallon, 3½d.; fuel cost per mile, 0·68d. in one week's running; fuel used, Light Diesoleum—a product of the Shell-Mex and B.P. organization, in conjunction with which the service was maintained.

W. and T. Avery, Ltd., of Soho Foundry, Birmingham, were showing weighing, measuring, counting, and testing machines for all purposes. Of special interest is a fully automatic testing machine suitable for tensile and compression tests, which is self-indicating. This is operated hydraulically. The indicator has two special features, the first being an electrically-operated maximum pointer, the arrangement of which completely eliminates friction during the weighing movement. When the maximum point has been reached an electrically-controlled friction brake comes into operation and holds the loose pointer at the maximum position. The second feature is the automatic load control, consisting of electric contacts operated by the pointer at the back of the dial. These contacts are coupled electrically with the pump unit and are so arranged that as the load is reduced or increased the appropriate circuit is closed and pressure added or removed from the system.

METAL MARKETS

Copper.—On balance standard prices kept fairly steady during February but the market closed with an easy undertone owing to the failure of consumption to improve to any extent. Developments in Germany and the United States were of course adverse to trade expansion. Electro eased off to about 4·90 cents per lb. c.i.f. Europe. The big Congo producer, Union Minière du Haut Katanga, is definitely to increase output on April 1 by 40%. Some of the higher-cost United States properties are expected to close down this year. A feature of the month was some fair Japanese buying.

Average price of Cash Standard Copper: February, 1933, £28 10s. 6d.; January, 1933, £28 12s.; February, 1932, £36 19s. 8d.; January, 1932, £39 10s. 1d.

Tin.—Prices fluctuated during February a little below the £150 level for cash, but the supporting " group " did not seem to experience any particular difficulty in bringing the price up to that level when deemed desirable. Industrial demand remained rather subdued but the February statistics recorded a further appreciable improvement which gave the market a fillip. The market, however, remains somewhat artificial.

Average price of Cash Standard Tin: February, 1933, £148 12s. 7d.; January, 1933, £145 15s. 10d.; February, 1932, £139 4s. 7d.; January, 1932, £140 5s. 6¾d.

Lead.—Steady conditions prevailed in this market during February, the explanation probably being that prices are now so low that everybody realizes that this fact must discount much that is adverse in the position. At the same time it is generally recognized that the statistical situation is discouraging. Consumption leaves much to be desired and the already large world stocks are probably still growing.

Average mean price of soft foreign lead: February, 1933, £10 11s. 6d.; January, 1933, £10 12s. 11d.; February, 1932, £14 11s. 3d.; January, 1932, £15 2s. 1¼d.

Spelter.—Values oscillated nervously owing to conflicting reports regarding the progress of the negotiations connected with the proposed re-establishment of the International Zinc Cartel but tended to harden at the end of the month when it was reported that renewal had been definitely agreed upon. So far the trouble within the Cartel does not seem to have had time to affect the statistical position adversely to any extent and as far as one can tell consumption is still in excess of current production (these remarks, of course, excluding the United States).

Average mean price of spelter: February, 1933, £13 19s. 10d.; January, 1933, £14 9s. 9d.; February, 1932, £14 1s. 7d.; January, 1932, £14 12s. 6d.

Iron and Steel.—The British pig-iron market displayed some favourable signs during February, consumers showing increased confidence, whilst the rolling mills benefited from the virtual exclusion of imported material. No. 3 Cleveland foundry pig-iron remained at 62s. 6d. for local delivery and 58s. 6d. f.o.b. for export. The finished steel market remained quiet but hopes are held that conditions may soon reflect the increased activity at the shipyards. The Continental steel market experienced a spurt of Far Eastern buying but has since quietened down. Some progress appears to have been made in connexion with the reorganization of the Continental Raw Steel Cartel and the proposed associated sales syndicates.

Iron Ore.—During February demand generally was not by any means brisk but at one time Germany bought some fair parcels. Mediterranean ores have been offering very cheaply, down to about 12s. c.i.f. being mentioned. Best Bilbao rubio is held for around 15s. 3d. per ton c.i.f.

Antimony.—The formation of the Antimony Trade Association for Hunan did not impart the lasting firmness to the market that at one time was thought possible. Demand continues slack and

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		Electrolytic / Best Selected.				Soft Foreign.	English.	Cash.	Forward.	
	Cash.	3 Months.		Cash.	3 Months.						
Feb.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	s. d.
10	29 4 4½	29 9 4½	33 10 0	31 5 0	149 16 3	150 1 3	14 5 0	10 8 9	12 0 0	16⅝	16 11/16	120 2
13	29 0 7½	29 5 7½	33 7 6	—	148 8 9	148 15 0	13 16 3	10 5 0	11 15 0	16 9/16	16⅝	119 10
14	28 12 6	28 16 10½	33 0 0	30 15 0	149 2 6	149 6 3	13 16 3	10 5 0	11 15 0	16 11/16	16½	119 9½
15	28 6 3	28 11 3	32 12 6	—	148 12 6	148 15 0	13 15 0	10 2 6	11 10 0	16 11/16	16⅝	119 9½
16	28 5 7½	28 10 7½	32 7 6	—	148 13 9	148 18 9	13 17 6	10 5 0	11 15 0	16 11/16	16⅝	121 1½
17	28 6 10½	28 10 7½	32 5 0	30 10 0	148 6 3	148 11 3	13 18 9	10 6 3	11 15 0	16 11/16	16⅝	120 9½
20	28 16 3	29 1 3	32 11 3	—	148 7 6	148 11 3	14 0 0	10 10 0	12 0 0	16 13/16	17	120 6½
21	28 8 9	28 13 1½	32 7 6	30 10 0	148 7 6	148 12 6	13 18 9	10 10 0	12 0 0	17 1/16	17 1/16	120 6½
22	28 8 1½	28 13 1½	32 12 6	—	148 6 3	148 13 9	14 0 0	10 11 3	12 0 0	17	17 1/16	121 8
23	28 8 9	28 13 9	32 12 6	—	147 17 6	148 8 9	14 1 3	10 11 3	12 0 0	17 1/16	17⅛	122 0
24	28 9 4½	28 14 4½	32 10 0	30 10 0	147 8 9	147 18 9	13 18 9	10 11 3	12 0 0	17 1/16	17⅛	121 10
27	28 6 3	28 13 1½	32 10 0	—	146 7 6	146 17 6	13 15 0	10 7 6	12 0 0	17 1/16	17⅛	121 5
28	27 18 9	28 4 4½	32 0 0	30 0 0	146 6 3	146 18 9	14 0 0	10 7 6	12 0 0	17⅛	17 3/16	121 2
Mar.												
1	28 0 7½	28 5 7½	32 0 0	—	148 17 6	149 2 6	14 5 0	10 8 9	12 0 0	17 1/16	17⅛	121 11½
2	27 17 6	28 3 9	32 0 0	—	147 16 3	148 8 9	14 2 6	10 8 9	12 0 0	17	17 1/16	121 7½
3	27 9 4½	27 14 4½	31 15 0	29 10 0	146 18 9	147 8 9	14 2 6	10 7 6	12 0 0	17 1/16	17⅛	120 8
6	27 3 9	27 9 4½	31 5 0	—	146 15 0	147 10 0	14 0 0	10 5 0	11 15 0	17 1/16	17⅛	119 7
7	27 12 6	27 18 9	31 10 0	29 10 0	145 15 0	146 7 6	14 6 3	10 8 9	12 0 0	17⅛	17 1/16	119 7
8	28 3 9	28 9 4½	32 5 0	—	148 13 9	149 6 3	14 11 3	10 17 6	12 5 0	18	18 1/16	118 11
9	28 10 7½	28 15 7½	32 10 0	—	149 0 0	149 11 3	14 13 9	11 2 6	12 10 0	18 1/16	18 1/16	119 7½

prices, after rising sharply on the news of the Association, have subsequently eased to about £23 5s. c.i.f. for forward shipment from China. English regulus remains at £37 10s. to £42 10s. per ton.

ARSENIC.—There is not much inquiry and Mexican high-grade is now offering at about £18 c.i.f. Cornish white remains at £19 f.o.r. mines.

BISMUTH.—Demand has not been very brisk and the official price was reduced during February to 4s. 6d. per lb. for 5 cwt. lots and over. Shortly afterwards it was announced that Bismuth metal had been placed on the Free List under the Import Duties Act.

CADMIUM.—The market is quietly steady at about 1s. 7d. per lb.

COBALT METAL.—The official price remains at 7s. per lb. for cwt. lots.

COBALT OXIDES.—Very little inquiry has been forthcoming just recently and prices are somewhat nominal at around 4s. 9d. to 5s. 2d. per lb. for black and 5s. 4d. to 5s. 7d. for grey.

CHROMIUM.—The market is steady at 2s. 9d. per lb. delivered.

TANTALUM.—Quiet conditions prevail but prices are unaltered at £15 per lb.

PLATINUM.—Apart from some Japanese buying the market has been slow and prices of refined metal have eased to about £7 per oz.

PALLADIUM.—There is hardly anything moving but quotations remain at £4 to £4 10s. per oz.

OSMIUM.—In the absence of business prices are upheld at £12 to £12 10s. per oz.

IRIDIUM.—Buyers remain very shy but prices are unaltered at £9 10s. per oz. for sponge and powder.

TELLURIUM.—Only trifling quantities are called for and quotations are quite nominal at around 20s. per lb.

SELENIUM.—Quotations are without change at 7s. 8d. to 7s. 9d. per lb. (gold) ex warehouse Liverpool, a quietly steady demand being maintained.

MANGANESE ORE.—Japan showed a little interest during February but on the whole the market continued in the doldrums. Prices are quotably unchanged at 9½d. per unit c.i.f. for best Indian ore and 8½d. to 9d. c.i.f. for 50 to 52% washed Caucasian.

ALUMINIUM.—There have been no developments of note. Leading interests maintain quotations at £100 per long ton, less 2% delivered for ingots and bars, and £80 (gold) per metric ton, for export.

SULPHATE OF COPPER.—Rather easier conditions have prevailed, English sulphate now being quoted at £15 15s. to £16 5s. per ton, less 5%.

NICKEL.—There has been a definite improvement in the demand during the past month but prices remain at £245 to £250 per ton.

CHROME ORE.—This industry remains very depressed, production being down to only a fraction of the highest levels. Prices, however, show no change at 80s. to 85s. for first quality 48% Rhodesian ore and 100s. to 105s. c.i.f. for 55 to 57% New Caledonian.

QUICKSILVER.—There is still only a very limited interest in this metal, prices having eased somewhat to £10 per bottle, net, for spot.

TUNGSTEN ORE.—Although there has been no appreciable demand just recently sellers in China have hardened a little in their ideas, forward shipment now being quoted at about 10s. 3d. per unit c.i.f.

MOLYBDENUM ORE.—There are fairly frequent inquiries for good quality concentrates, prices being well maintained at 47s. 6d. to 50s. per unit c.i.f. for 80 to 85% material.

GRAPHITE.—Quotations are largely nominal at around £16 to £18 per ton c.i.f. for 85 to 90% raw Madagascar flake and £15 to £17 c.i.f. for 90% Ceylon lumps.

SILVER.—At the beginning of the month China showed some interest but subsequently dull conditions developed and spot bars, after beng quoted at 17d. on February 1, declined to 16 9/16d. on February 11. In the latter half of the month China and India showed a little more interest whilst America was not offering so freely. Prices rose fairly sharply to 17⅛d. on February 28.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
February, 1932	869,711	44,301	914,012
March	914,017	46,018	960,035
April	901,894	47,902	949,796
May	919,223	46,421	965,644
June	913,297	45,714	959,011
July	933,947	47,213	981,160
August	943,174	48,148	991,322
September	912,870	48,631	961,501
October	926,686	48,279	974,965
November	930,085	48,631	978,716
December	931,749	48,869	980,618
January, 1933	919,125	48,332	967,457
February	835,931	47,214	883,145

TRANSVAAL GOLD OUTPUTS.

	January.		February.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	112,000	£216,041	106,500	£201,403
City Deep	81,000	21,256	74,500	19,578
Cons. Main Reef	75,200	25,350	70,000	22,926
Crown Mines	292,000	91,264	262,000	80,581
Daggafontein	47,700	£110,768	43,900	£106,572
D'rb'n Roodepoort Deep	52,000	15,408	46,800	13,330
East Geduld	64,000	21,456	60,000	20,569
East Rand P.M.	163,000	41,756	150,000	37,874
Geduld	87,800	27,218	80,500	25,052
Geldenhuis Deep	71,000	16,112	71,000	15,232
Glynn's Lydenburg	7,700	2,636	7,000	2,545
Government G.M. Areas	209,000	£578,927	192,000	£514,386
Kleinfontein	52,400	£10,115	46,200	£9,539
Langlaagte Estate	81,000	£147,557	75,000	£129,498
Luipaard's Vlei	34,700	8,199	33,000	7,866
Modderfontein New	176,000	59,107	162,000	50,338
Modderfontein B	77,500	19,922	71,000	17,151
Modderfontein Deep	44,600	19,182	41,800	17,980
Modderfontein East	76,000	21,191	71,500	19,009
New State Areas	91,000	£267,280	84,000	£241,388
Nourse	72,000	20,476	67,200	18,276
Randfontein	255,000	£436,376	235,000	£390,150
Robinson Deep	100,000	26,942	92,000	25,197
Rose Deep	64,200	12,650	60,000	11,696
Simmer and Jack	83,100	20,221	79,000	19,226
Springs	79,200	£227,727	75,500	£213,408
Sub Nigel	37,800	33,941	35,000	33,363
Transvaal G.M. Estates	19,300	5,529	18,300	4,964
Van Ryn	52,000	£67,870	48,000	£63,034
Van Ryn Deep	72,000	£135,654	70,000	£121,882
West Rand Consolidated	98,000	£152,146	88,000	£139,733
West Springs	81,000	£112,054	74,500	£102,213
Witw'tersr'nd (Knights)	73,000	£78,325	66,000	£67,537
Witwatersrand Deep	46,800	15,856	45,400	14,617

Feb. gold at 119s. per oz.

COST AND PROFIT ON THE RAND, Etc.

Compiled from official statistics published by the Transvaa 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.	£
Nov., 1931	2,726,720	27 10	19 5	8 5	1,144,208
December	2,793,900	27 10	19 5	8 5	1,173,732
January, 1932	2,880,500	27 5	19 4	8 1	1,163,434
February	2,775,400	27 8	19 6	8 2	1,133,212
March	2,901,300	27 10	19 7	8 3	1,200,278
April	2,883,500	27 9	19 5	8 4	1,196,011
May	2,964,100	27 6	19 2	8 4	1,228,198
June	2,927,200	27 9	19 3	8 6	1,241,392
July	2,993,600	27 5	19 0	8 5	1,260,744
August	3,027,700	27 6	19 1	8 5	1,277,923
September	2,944,800	27 6	19 1	8 5	1,234,584
October	2,994,500	27 5	19 0	8 5	1,26 ,274
November	2,949,050	27 8	19 2	8 6	1,256,717
December	2,972,000	27 10	19 5	8 5	1,255,797
January, 1933	—	—	—	—	2,802,754

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
February 29, 1932	216,171	12,177	1,363	229,711
March 31	214,024	12,009	—	226,033
April 30	214,334	11,943	—	226,277
May 31	215,926	11,972	—	227,898
June 30	217,077	11,833	—	228,910
July 31	217,525	12,056	—	229,581
August 31	217,658	11,727	—	229,385
September 30	216,398	11,642	—	228,040
October 31	216,298	11,353	—	227,651
November 30	219,024	11,207	—	230,231
December 31	221,008	11,310	—	232,318
January 31, 1933	222,005	11,292	—	233,297
February 28	222,589	11,472	—	234,061

PRODUCTION OF GOLD IN RHODESIA.

	1930	1931	1932	1933
	oz.	oz.	oz.	oz.
January	46,121	45,677	42,706	48,656
February	43,385	42,818	45,032	—
March	45,511	42,278	47,239	—
April	45,806	43,776	46,487	—
May	47,645	43,731	46,854	—
June	45,208	44,118	48,441	—
July	45,810	44,765	47,331	—
August	46,152	43,202	49,254	—
September	46,151	42,846	50,198	—
October	45,006	44,260	50,416	—
November	44,351	44,516	48,082	—
December	46,485	50,084	52,096	—

RHODESIAN GOLD OUTPUTS.

	January.		February.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	25,600	9,545	23,600	8,706
Globe and Phœnix	6,082	5,749	6,042	5,239
Lonely Reef	10,800	2,120	10,200	2,079
Luiri Gold	—	—	—	—
Rezende	6,500	2,512	6,100	2,357
Sherwood Star	5,600	£6,166	5,600	£7,010
Wanderer Consolidated	16,000	3,593	14,400	3,287

WEST AFRICAN GOLD OUTPUTS.

	January.		February.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	7,305	£22,183		
Ashanti Goldfields	13,440	14,730	12,542	14,726
Taquah and Abosso	10,206	3,302	9,363	3,488

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.
	Oz.	Oz.	Oz.
February, 1932	44,672	—	981
March	47,108	—	769
April	48,936	—	1,216
May	53,928	—	692
June	50,079	—	920
July	53,585	—	1,391
August	51,536	—	1,026
September	54,427	—	1,160
October	51,236	—	2,169
November	53,956	38,612†	4,386
December	52,282	—	—
January, 1933	45,755	—	—
February	47,281	—	—

† Period Jan.-Nov. 1932.

AUSTRALASIAN GOLD OUTPUTS.

	January.		February.	
	Tons.	Value £	Tons.	Value £
Associated G.M. (W.A.)	5,234	5,700	4,766	5,923
Blackwater (N.Z.)	3,787	1,752*	3,310	1,702*
Boulder Persev'ce (W.A.)	6,381	12,438	6,624	11,676
Grt. Boulder Pro. (W.A.)	6,374	4,448*	—	—
Lake View & Star (W.A.)	34,453	37,293	—	—
Sons of Gwalia (W.A.)	12,116	13,162	9,704	14,426
South Kalgurli (W.A.)	7,514	11,870	7,897	12,790
Waihi (N.Z.)	11,780‡	3,502* / 21,013†	18,947‡‡	5,636* / 29,801†
Wilma	31,116	8,600*	—	—

* Oz. gold. † Oz. silver. ‡ To Jan. 21. ‡‡ To Feb. 18.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	January.		February.	
	Tons Ore.	Total Oz.	Tons Ore.	Total Oz.
Champion Reef	9,430	5,552	9,540	5,015
Mysore	14,852	7,671	13,415	6,937
Nundydroog	19,643	10,342*	18,098	13,613†
Ooregum	11,750	4,224	11,750	3,866

* 1,641 oz. from 1,628 tons Balaghat ore. † 1,155 oz. from 1,340 tons Balaghat ore.

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	January.		February.	
	Tons.	Value £	Tons.	Value £
Bulolo Gold	—	124,877*d*	—	—
Chosen Corp. (Korea)	10,280	16,150	8,930	17,104
Frontino Gold (C'lbia)	3,330	14,286	3,320	15,445
Fresnillo	82,197	1,259*d*	—	—
New Goldfields of Venezuela	8,592	2,166*	8,110	2,262*
Oriental Cons. (Korea)	—	89,543*d*	—	—
St. John del Rey (Brazil)	—	38,500	—	38,500
Santa Gertrudis (Mexico)	18,739	7,730*d*‡	—	—
Viborita	—	—	—	—
West Mexican Mines	1,280	19,500*d*	—	—

d Dollars. * Oz. gold. ‡ Loss.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

Estimated at 72% of Concentrate shipped to Smelters. Long Tons.

July, 1932	1,437	January, 1933	2,312
August	1,164	February	2,154
September	1,123	March	—
October	2,273	April	—
November	2,242	May	—
December	1,590	June	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	Dec.	Jan.	Feb.
Ayer Hitam	—	113	—
Batu Caves	—	43	—
Changkat	60	58	60
Gopeng	72½*	—	—
Hongkong Tin	—	—	—
Idris Hydraulic	—	17½	18
Ipoh	—	133½	55½
Kampar Malaya	—	—	—
Kampong Lanjut	—	—	—
Kamunting	146	150	—
Kent (F.M.S.)	—	—	—
Killinghall	—	—	—
Kinta	34*	—	—
Kinta Kellas	—	—	—
Kramat Tin	85	78	70
Kuala Kampar	50	—	—
Kundang	—	—	—
Lahat	4½	14½	11
Lower Perak	—	—	—
Malaya Consolidated	—	—	—
Malayan Tin	40½	80½	81
Malim Nawar	—	—	—
Pahang	78	78	78
Penawat	—	52½	48½
Pengkalen	67*	—	—
Petaling	2*	—	—
Rahman	—	25	25
Rambutan	—	—	—
Rantau	—	30	—
Rawang	37	18	33
Rawang Concessions	46	42	29
Renong	17½	22½	25½
Selayang	—	—	—
Southern Kampar	—	93	78½
Southern Malayan	48	53½	53½
Southern Perak	—	41½	15½
Southern Tronoh	18	18	18
Sungei Besi	—	—	—
Sungei Kinta	—	—	—
Sungei Way	35½	38½	53½
Taiping	—	9	—
Tanjong	—	—	—
Tekka	39*	—	—
Tekka Taiping	65*	—	—
Temoh	—	—	—
Tronoh	39	39	39
Ulu Klang	—	—	—

* 3 months to Dec. 31.

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Dec.	Jan.	Feb.
Anglo-Nigerian	13	15	18
Associated Tin Mines	107½	104½	100½
Baba River	3	4	3
Batura Monguna	—	—	—
Bisichi	18½	16	—
Daffo	—	—	—
Ex-Lands	16½	—	—
Filani	—	—	—
Jantar	9	10	—
Jos	7¾	7¾	—
Juga Valley	5½	5½	5½
Kaduna Syndicate	11½	12½	—
Kaduna Prospectors	5½	6½	—
Kassa	4½	3	3
London Tin	73	76	76
Lower Bisichi	3	3	—
Naraguta Extended	—	—	—
Nigerian Consolidated	4½	4	5
Offin River	—	—	—
Ribon Valley	11½	10	9
Tin Fields	—	—	—
United Tin Areas	10	10	9
Yarde Kerri	—	—	—

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Dec.	Jan.	Feb.
Anglo-Burma (Burma)	41½	38	23
Aramayo Mines (Bolivia)	110	116	123
Bangrin (Siam)	70½	43	—
Beralt	22½*	21*	24*
Consolidated Tin Mines (Burma)	79	90	82
East Pool (Cornwall)	44½	46½	—
Fabulosa (Bolivia)	36	39	—
Kagera (Uganda)	31	25	—
Kamra	—	—	—
Malaysiam Tin	14½	14½	14½
Mawchi	220*	224*	—
Patino	—	—	—
Pattani	—	—	—
San Finx (Spain)	—	—	—
Siamese Tin (Siam)	106½	137½	—
South Crofty	55½	50	49½
Tavoy Tin (Burma)	84½	69	38½
Tongkah Harbour (Siam)	26	35	50
Toyo (Japan)	68½	56	54½
Zaaiplaats	15	—	—

* Tin and Wolfram.

COPPER LEAD, AND ZINC OUTPUTS.

		Jan.	Feb.
Britannia Lead	Tons refined lead	3,851	—
	Oz. refined silver	253,458	—
Broken Hill South	Tons lead conc.	7,059*	—
	Tons zinc conc.	7,134*	—
Burma Corporation	Tons refined lead	5,880	5,880
	Oz. refined silver	520,889	520,160
Electrolytic Zinc	Tons zinc	—	—
Indian Copper	Tons copper	400	—
	Tons yellow metal	513	—
Messina	Tons copper	809	845
Mount Isa	Tons lead bullion	5,654	—
Mount Lyell	Tons concentrates	3,314	2,850
North Broken Hill	Tons lead conc.	3,280	4,870
	Tons zinc conc.	3,260	4,550
Rhodesia Broken Hill	Tons Zinc	1,051	1,420
	Tons V_2O_5 conc.	20	20
Roan Antelope	Tons blister copper	—	—
Sulphide Corporation	Tons lead conc.	688*	—
	Tons zinc conc.	1,021*	—
Trepca	Tons lead conc.	4,990	4,305
	Tons zinc conc.	7,062	6,379
Zinc Corporation	Tons lead conc.	6,861*	—
	Tons zinc conc.	5,204*	—

* Six weeks to Feb. 11.

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

		Dec.	Jan.
Iron Ore	Tons	159,571	163,583
Manganese Ore	Tons	6,351	7,102
Iron and Steel	Tons	72,748	69,472
Copper and Iron Pyrites	Tons	26,207	17,875
Copper Ore, Matte, and Prec.	Tons	2,411	735
Copper Metal	Tons	12,971	12,217
Tin Concentrate	Tons	3,462	2,127
Tin Metal	Tons	170	140
Lead Pig and Sheet	Tons	19,844	22,125
Zinc (Spelter)	Tons	5,330	4,061
Zinc Sheets, etc.	Tons	1,709	1,323
Zinc Oxide	Tons	14	41
Zinc Ore	Tons	6,575	12,006
Aluminium	Tons	568	8,935*
Mercury	Lb.	92,862	171,957
White Lead	Cwt.	4,942	5,170
Barytes, ground	Cwt.	22,000	20,345
Asbestos	Tons	2,350	1,114
Boron Minerals	Tons	469	1,413
Borax	Cwt.	15,926	4,722
Basic Slag	Tons	—	—
Superphosphates	Tons	2,298	1,200
Phosphate of Lime	Tons	24,444	32,201
Mica	Tons	107	184
Tungsten Ores	Tons	413	298
Sulphur	Tons	2,905	7,952
Nitrate of Soda	Cwt.	1 602	2,091
Potash Salts	Cwt.	141,506	113,019
Petroleum: Crude	Gallons	29,992,986	34,085,889
Lamp Oil	Gallons	36,385,226	16,005,910
Motor Spirit	Gallons	82,619,717	84,120,905
Lubricating Oil	Gallons	7,065,418	8,109,101
Gas Oil	Gallons	8,801,775	9,687,889
Fuel Oil	Gallons	45,982,069	43,584,633
Asphalt and Bitumen	Tons	10,383	10,078
Paraffin Wax	Cwt.	110.149	74,026

* Cwt.

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES.

In Tons.

	Dec.	Jan.	Feb.
Anglo-Ecuadorian	16,007	16,117	14,780
Apex Trinidad	43,020	45,190	44,500
Attock	1,669	1,533	1,259
British Burmah	3,789	3,911	4,241
British Controlled	39,589	—	—
Kern Mex	847	832	760
Kern River (Cal.)	3,292	3,346	3,244
Kern Romana	84	77	74
Kern Trinidad	1,561	1,903	2,641
Lobitos	24,287	23,071	20,290
Phœnix	78,406	65,719	59,338
St. Helen's Petroleum	4,218	3,967	3,795
Steaua Romana	100,837	90,564	—
Tampico	2,290	2,219	2,091
Tocuyo	1,186	1,219	1,073
Trinidad Leaseholds	29,950	28,550	28,600

QUOTATIONS OF OIL COMPANIES' SHARES.

Denomination of Shares £1 unless otherwise noted.

	Feb. 9, 1933.	Mar. 9, 1933.
	£ s. d.	£ s. d.
Anglo-Ecuadorian	11 0	10 6
Anglo-Egyptian B	1 10 0	1 10 0
Anglo-Persian 1st Pref.	1 8 3	1 7 6
" " Ord.	1 17 6	1 16 9
Apex Trinidad (5s.)	18 9	1 0 6
Attock	8 9	7 6
British Burmah (8s.)	3 6	4 0
British Controlled ($5)	3 9	3 6
Burmah Oil	3 0 0	2 17 6
Kern River Cal. (10s.)	2 3	2 0
Lobitos, Peru	1 12 6	1 11 3
Mexican Eagle, Ord. (4 pesos)	7 3	6 6
" " 8% Pref. (4 pesos)	6 6	5 9
Phœnix, Roumanian	9 6	8 3
Royal Dutch (100 fl.)	17 15 0	16 15 0
Shell Transport, Ord.	2 5 0	2 2 6
" " 5% Pref. (£10)	11 2 6	11 7 6
Steaua Romana	8 0	7 0
Trinidad Leaseholds	2 7 6	2 7 6
United British of Trinidad (6s. 8d.)	4 6	4 0
V.O.C. Holding	1 10 0	1 8 0

PRICES OF CHEMICALS. Mar. 9.

These quotations (some of which are affected by the devaluation of the pound sterling) are not absolute; they vary according to quantities required and contracts running.

		£ s. d.
Acetic Acid, 40%	per cwt.	1 0 9
" " 80%	"	1 18 5
" " Glacial	per ton	59 0 0
Alum	"	8 7 6
Aluminium Sulphate, 17 to 18%	"	6 15 0
Ammonium, Anhydrous	per lb.	1 1
" 0·880 solution	per ton	15 10 0
" Carbonate	"	27 10 0
" Nitrate (British)	"	16 0 0
" Phosphate, comml.	"	40 0 0
" Sulphate, 20·6% N.	"	6 10 0
Antimony, Tartar Emetic, 43/44%	per lb.	10
" Sulphide, golden	"	9
Arsenic, White (foreign)	per ton	20 0 0
Barium, Carbonate (native), 94%	"	4 10 0
" Chloride	"	10 10 0
Barytes	"	8 5 0
Benzol, standard motor	per gal.	1 6½
Bleaching Powder, 35% Cl.	per ton	8 15 0
Borax	"	16 10 0
Boric Acid	"	26 10 0
Calcium Chloride, solid, 70/75%	"	5 15 0
Carbolic Acid, crude 60's	per gal.	3 0
" " crystallized, 40°	per lb.	1 0
Carbon Disulphide	per ton	30 0 0
Citric Acid	per lb.	9½
Copper Sulphate	per ton	15 0 0
Creosote Oil (f.o.b. in Bulk)	per gal.	3¾
Cresylic Acid, 98–100%	"	1 11
Hydrofluoric Acid, 59/60%	per lb.	6
Iodine Resub. B.P. (28 lb. lots)	"	14 11
Iron, Nitrate 80° Tw.	per ton	6 0 0
" Sulphate	"	1 15 0
Lead, Acetate, white	"	32 10 0
" Nitrate (ton lots)	"	27 10 0
" Oxide, Litharge	"	25 10 0
" White	"	37 10 0
Lime, Acetate, brown	"	9 5 0
" " grey, 80%	"	13 5 0
Magnesite, Calcined	"	8 5 0
Magnesium Chloride	"	6 10 0
" Sulphate, comml.	"	4 10 0
Methylated Spirit Industrial 61 O.P.	per gal.	2 0
Nitric Acid, 80° Tw.	per ton	19 0 0
Oxalic Acid	per ton	48 0 0
Phosphoric Acid. (Conc. 1·750)	per lb.	10
Pine Oil	per cwt.	2 7 6
Potassium Bichromate	per lb.	5
" Carbonate, 96/98%	per ton	32 0 0
" Chlorate	per lb.	4
" Chloride, 80%	per ton	9 10 0
" Ethyl Xanthate	per 100 kilos	7 10 0
" Hydrate (Caustic) 88/90%	per ton	40 0 0
" Nitrate	"	30 0 0
" Permanganate	per lb.	8½
" Prussiate, Yellow	per ton	75 0 0
" " Red	per lb.	2 0
" Sulphate, 90%	per ton	10 10 0
Sodium Acetate	"	23 10 0
" Arsenate, 45%	"	23 0 0
" Bicarbonate	"	10 10 0
" Bichromate	per lb.	4
" Carbonate (Soda Ash), 58%	per ton	6 0 0
" " (Crystals)	"	5 2 6
" Chlorate	"	32 0 0
" Cyanide, 100% NaCN basis	per lb.	8
" Ethyl Xanthate	per 100 kilos	7 1 6
" Hydrate, 76%	per ton	14 0 0
" Hyposulphite, comml.	"	9 2 6
" Nitrate (refined)	"	8 10 0
" Phosphate, comml.	"	12 0 0
" Prussiate	per lb.	4½
" Silicate	per ton	9 10 0
" " (liquid, 140° Tw.)	"	8 10 0
" Sulphate (Glauber's Salt)	"	2 15 0
" " (Salt-Cake)	"	3 1 0
" Sulphide, Conc., 60/65%	"	10 15 0
" Sulphite, pure	per cwt.	14 0
Sulphur, Flowers	per ton	9 15 0
" Roll	"	9 15 0
Sulphuric Acid 168° Tw.	"	4 5 0
" " free from Arsenic, 140° Tw.	"	3 0 0
Superphosphate of Lime (S.P.A. 16%)	"	3 4 0
Tartaric Acid	per lb.	10½
Turpentine	per ton	65 5 0
Tin Crystals	per lb	1 0
Titanous Chloride	"	10½
Zinc Chloride	per ton	9 10 0
" Dust, 90/92%	"	20 0 0
" Oxide (White Seal)	"	35 0 0
" Sulphate	"	9 0 0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

GOLD AND SILVER:	Feb. 9, 1933. £ s. d.	Mar. 9, 1933. £ s. d.
SOUTH AFRICA:		
Brakpan	5 2 6	5 8 9
City Deep	1 1 3	1 5 0
Consolidated Main Reef	2 3 0	2 0 0
Crown Mines (10s.)	7 11 3	7 17 6
Daggafontein	3 2 6	3 5 0
Durban Roodepoort Deep (10s.)	1 16 9	1 14 3
East Geduld	4 1 3	4 10 0
East Rand Proprietary (10s.)	1 7 6	1 3 9
Geduld	5 2 6	5 4 3
Geldhenhuis Deep	1 8 9	1 4 3
Glynn's Lydenburg	1 2 6	1 1 9
Government Gold Mining Areas (5s.)	2 0 0	2 0 0
Grootvlei	1 13 9	1 17 6
Langlaagte Estate	1 10 0	1 7 6
Luipaard's Vlei (2s.)	10 0	8 3
Modderfontein, New (10s.)	3 2 6	3 1 9
Modderfontein B (5s.)	17 6	19 3
Modderfontein Deep (5s.)	19 3	17 3
Modderfontein East	2 17 6	2 12 6
New Kleinfontein	1 11 9	1 7 6
New State Areas	2 16 9	2 13 9
Nourse	2 3 9	1 18 0
Randfontein	2 12 6	2 8 3
Robinson Deep A (1s.)	13 9	13 9
" " B (7s. 6d.)	1 9 9	1 6 9
Rose Deep	1 1 3	18 0
Simmer and Jack (2s. 6d.)	7 9	6 9
Springs	4 12 6	4 13 0
Sub Nigel (10s.)	6 3 9	7 5 0
Van Ryn	1 5 0	1 3 9
Van Ryn Deep	1 13 9	1 11 3
Village Deep (9s. 6d.)	1 6	1 4
West Rand Consolidated (10s.)	1 3 0	1 0 0
West Springs	1 9 3	1 10 9
Witwatersrand (Knights)	1 3 3	1 1 3
Witwatersrand Deep	1 6 3	1 3 9
RHODESIA:		
Cam and Motor	2 8 3	2 1 3
Globe and Phœnix (5s.)	16 6	16 0
Lonely Reef	12 6	10 0
Luiri Gold (5s.)	1 0	9
Rezende (17s. 6d.)	1 6 3	1 6 3
Sherwood Starr (5s.)	13 0	11 6
Wanderer	18 3	17 6
GOLD COAST:		
Ariston (2s. 6d.)	7 11	6 9
Ashanti (4s.)	1 16 9	1 14 9
Taquah and Abosso (4s.)	10 0	9 0
AUSTRALASIA:		
Associated Gold (4s.), W.A.	3 0	2 9
Golden Horseshoe (4s.), W.A.	4 0	3 9
Great Boulder Propriet'y (2s.), W.A.	7 3	6 6
Lake View and Star (4s.), W.A.	18 9	17 0
Sons of Gwalia (10s.), W.A.	16 3	15 3
South Kalgurli (10s.), W.A.	1 3 0	1 3 3
Waihi (5s.), N.Z.	18 6	17 0
Wiluna Gold, W.A.	1 18 6	1 19 6
INDIA:		
Champion Reef (10s.)	1 3 3	19 3
Mysore (10s.)	15 3	12 6
Nundydroog (10s.)	2 4 6	2 0 0
Ooregum (10s.)	7 0	6 3
AMERICA:		
Camp Bird (2s.), Colorado	—	10
Exploration (10s.)	2 0	2 0
Frontino and Bolivia, Colombia	1 4 6	1 6 3
Mexican Corporation (10s.), Mexico	4 3	5 0
New Goldfields of Venezuela (5s.)	4 9	4 6
St. John del Rey, Brazil	1 4 3	1 2 6
Santa Gertrudis, Mexico	4 9	6 3
Viborita (5s.), Colombia	3 9	3 6
MISCELLANEOUS:		
Chosen, Korea	11 0	7 0
New Guinea	5 6	4 0

COPPER:		
Bwana M'Kubwa (5s.), Rhodesia	3 9	3 6
Esperanza	6 3	6 3
Indian (2s.)	1 6	1 9
Loangwa (5s.), Rhodesia	1 6	1 6
Mason and Barry	10 0	10 0
Messina (5s.), Transvaal	6 6	6 0
Mount Lyell, Tasmania	16 0	15 6
Namaqua (£2), Cape Province	2 0	2 0
Rhodesia-Katanga	10 0	10 0
Rio Tinto (£5), Spain	16 12 6	15 10 0
Roan Antelope (5s.), Rhodesia	12 6	12 0
Tanganyika Concessions	19 3	17 6
Tharsis (£2), Spain	3 2 6	2 18 9

LEAD-ZINC:	Feb. 9, 1933. £ s. d.	Mar. 9, 1933. £ s. d.
Amalgamated Zinc (8s.), N.S.W.	7 6	7 6
Broken Hill Proprietary, N.S.W.	1 1 6	1 1 9
Broken Hill, North, N.S.W.	2 13 9	2 12 6
Broken Hill, South, N.S.W.	1 16 9	1 15 0
Burma Corporation (10 rupees)	10 3	11 3
Electrolytic Zinc Pref., Tasmania	12 6	10 6
Mount Isa, Queensland	7 6	8 0
Rhodesia Broken Hill (5s.)	2 0	1 9
San Francisco (10s.), Mexico	7 9	9 3
Sulphide Corporation (15s.), N.S.W.	6 0	6 6
ditto, Pref.	8 3	8 6
Trepca (5s.), Yugoslavia	7 9	9 0
Zinc Corporation (10s.), N.S.W.	1 1 3	1 0 9
ditto, Pref.	3 5 0	3 6 3
TIN:		
Aramayo Mines (25 fr.), Bolivia	11 3	11 3
Associated Tin (5s.), Nigeria	4 3	4 0
Ayer Hitam (5s.), Malay	11 3	11 3
Bangrin, Siam	12 0	11 3
Bisichi (10s.), Nigeria	5 0	4 9
Consolidated Tin Mines of Burma	2 9	2 9
East Pool (5s.), Cornwall	1 0	10½
Ex-Lands Nigeria (2s.)	1 3	1 0
Geevor (10s.), Cornwall	—	2 6
Gopeng, Malay	1 6 3	1 7 6
Hongkong (5s.), Malay	12 6	12 0
Idris (5s.), Malay	4 6	4 3
Ipoh Dredging (16s.), Malay	13 9	13 6
Kaduna Prospectors (5s.), Nigeria	5 0	5 0
Kaduna Syndicate (5s.), Nigeria	12 6	12 6
Kamunting (5s.), Malay	6 6	6 0
Kepong, Malay	6 3	6 3
Kinta (5s.), Malay	4 0	4 0
Kinta Kellas (5s.), Malay	3 6	3 0
Kramat Pulai, Malay	15 0	13 9
Kramat Tin, Malay	1 6 0	1 6 0
Lahat, Malay	—	—
Malayan Tin Dredging (5s.)	17 0	16 6
Naraguta, Nigeria	8 9	8 9
Pahang Consolidated (5s.), Malay	4 3	4 3
Penawat ($1), Malay	1 1	1 3
Pengkalen (5s.), Malay	8 6	8 0
Petaling (2s. 4d.), Malay	10 9	10 6
Rambutan, Malay	4 0	4 0
Renong Dredging, Malay	15 0	14 9
Siamese Tin (5s.), Siam	8 0	7 3
South Crofty (5s.), Cornwall	2 0	2 0
Southern Malayan (5s.)	10 9	10 6
Southern Perak, Malay	1 5 0	1 5 0
Southern Tronoh (5s.), Malay	4 6	4 3
Sungei Besi (5s.), Malay	9 0	8 9
Sungei Kinta, Malay	8 0	8 0
Tanjong (5s.), Malay	6 0	5 9
Tavoy (4s.), Burma	5 0	4 6
Tekka, Malay	8 9	8 9
Tekka Taiping, Malay	6 3	7 6
Temoh, Malay	10 0	9 6
Toyo (2s. 6d.), Japan	3 3	3 6
Tronoh (5s.), Malay	14 9	14 3

DIAMONDS:		
Consol. African Selection Trust (5s.)	17 6	15 6
Consolidated of S.W.A. (10s.)	5 9	4 0
De Beers Deferred (£2 10s.)	5 7 6	4 15 0
Jagersfontein	1 6 3	1 2 6
Premier Preferred (5s.)	1 8 9	1 5 0

FINANCE, ETC.:		
Anglo American Corporation (10s.)	18 3	16 0
Anglo-Continental (10s.)	4 6	4 6
Anglo-French Exploration	1 0 0	18 0
Anglo-Oriental (5s.)	6 0	6 0
ditto, Pref.	9 0	8 9
British South Africa (15s.)	19 0	15 6
Central Mining (£8)	16 2 6	15 0 0
Consolidated Gold Fields	2 7 6	2 2 6
Consolidated Mines Selection (10s.)	12 0	9 0
Fanti Consols (8s.)	8 3	8 3
General Mining and Finance	1 17 6	1 12 6
Gold Fields Rhodesian (10s.)	5 3	4 3
Johannesburg Consolidated	2 3 9	1 19 6
London Tin Corporation (10s.)	9 9	8 6
Minerals Separation	3 5 0	3 2 6
Mining Trust	4 9	4 3
National Mining (8s.)	9	8
Rand Mines (5s.)	5 8 0	5 2 6
Rand Selection (5s.)	15 0	14 6
Rhodesian Anglo American (10s.)	10 3	9 6
Rhodesian Selection Trust (5s.)	5 3	4 9
Rhokana Corp.	4 5 0	4 5 0
Tigon (5s.)	3 3	3 3
Union Corporation (12s. 6d.)	3 12 6	3 8 9
Venture Trust (6s. 8d.)	7 0	6 6

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, 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.

THE WEDZA PLATINUM MINE, SOUTHERN RHODESIA

In the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for December, 1932, E. Golding gives some notes on the Wedza platinum mine, Southern Rhodesia. The author recalls that a discovery of platinum in the southern extension of the Great Dyke was made by Granger Brothers in 1925. The occurrence, known as the Wedza platinum mine, is in a well-exposed part of the Great Dyke, about 22 miles north-west by north of Belingwe and three miles west of Wedza Siding, on the Somabula-Shabani railway line, and in the Bulawayo mining district. In the Geological Survey Short Report No. 19, "Platinum in Southern Rhodesia," Mr. B. Lightfoot refers to this section of the Great Dyke as follows: "The felspar-rich norite forms a high plateau on Wedza, Sandeman's, Bannockburn, and Springs farms, which is broken right across on Wedza farm. Further to the south a lower range of norite runs away to the south. The platinum reef runs across both these areas." In "Platinum Deposits and Mines of South Africa" (p. 250), the late Dr. Percy A. Wagner gives a detailed section across this reef in descending order as follows:—

Hanging-wall: Felspathic pyroxenite—thickness unknown.

"Potato reef" (platinum bearing)—16 ft. to 2 ft. 9 in.

"Reef" (platinum bearing)—3 to 4 ft.

Rather fine-grained "reef" (barren)—6 ft.

An examination of concentrate made by Mr. R. A. Cooper for Dr. Wagner proved that the "platinum is present mainly as minute cubo-octahedrons of sperrylite. Minute flattened crystals probably represent cooperite. The presence of the latter mineral is also indicated by the fact that the concentrate . . . contained two per cent. of sulphur . . ."

On the Wedza platinum mine ideal conditions prevail for mining, which was carried out by open workings. No explosives were used, the ore first being removed with pick and shovel by undercutting and then the overburden dropped, this latter being used to build up the track and keep it near the working faces. The ore was gravitated to the mill in trucks. Mining costs were consequently low, being only 4d. per ton. The tonnage treated was 600 tons per month and the ore in sight appeared to be unlimited. Just above the mill site, where the ore-body had been opened up, faces were exposed for 1,900 ft., varying in thickness from 4 to 16 ft. and assaying between 2 and 3 dwt. per ton platinum group metals. The farthest working point was only two hundred yards away from the mill. A considerable amount of work was also done in tracing and exploring the reef beyond this point and in places adits have been driven 60 to 80 feet into the body.

The power unit consisted of 150 h.p. twin cylinder Premier Crossley suction gas-engine with a charcoal producer plant, a Marshall vertical steam-engine being used as a starter. A three-throw Evans ram pump driven by an electric motor was used to pump water from a spruit running 500 yards from the mill.

The ore was first broken in a jaw crusher, raised to the bin by a mechanical haulage and fed into a Hardinge mill 6 ft. 6 in. in diameter. In lieu of steel balls in the mill it was found quite satisfactory and cheaper to employ pebbles of speckled or spotted norite, which were obtained from the hill above the mill site. The pulp leaving the mill was lifted to a classifier by a Frenier pump and the oversize returned to the mill. A second classifier separated the slime from the sand. The sand then passed down a race to a steady-head, from which distribution over the strakes was controlled by pipes. These sand strakes were simply sloping floors of cement, the first group being four in number, 20 ft. long and 3 ft. wide, with riffles 1 in. apart inclined against the pulp flow. The space between each strake was 14 in. wide. Below this was a group of three strakes 30 ft. long, followed by one of the same length from which the sand went to the dump. At the side of each strake a groove ran the full length, into which the concentrate caught in the riffles was washed. From the grooves the concentrate entered false launders leading to pits arranged at intervals of 50 ft., a system which simplified the washing down.

Parallel to the sand strakes similar contrivances operated for the treatment of the slime. The effect of the riffles on the pulp flow was a continual rolling, rippling motion, which movement washed the platinum free from adhering sand or gangue and caused the metal to be retained in the riffles. At intervals each strake was shut off and the concentrate washed by hose from the riffles into the side groove, thence to the false launder and into the pits.

The crude concentrate from the pits was collected and treated on a curvilinear table, the overflow being reconcentrated on an Isbell film vanner. The tailing from the vanner returned to the classifier and thus into circuit again.

The final concentrate from the table and vanner were collected every twenty-four hours, dried separately, and then placed into two specially-constructed screen boxes (200 mesh) attached to the base of an old curvilinear table driven by a belt from the line shaft, a shaking device which proved very efficient. The plus product carried a little platinum and was returned to the circuit. The minus product contained a high percentage of magnetic iron, which was removed by a magnetic separator with very little loss of platinum. The concentrate was packed in drums and shipped overseas.

The Wedza platinum mine was the only notable effort made in Southern Rhodesia to produce platinum during the boom and undoubtedly it represents an enterprise which, but for certain factors, might have been successful. The grade of ore was unfortunately rather low, the average being somewhere in the region of 2·5 dwt. per ton. Further, the recovery rarely exceeded 50%, due to the tendency of the very fine platinum grains to float on the surface of the pulp, thus avoiding contact with the riffles. Unlike most of the Transvaal deposits, the occurrence so far as exposed was entirely an oxidized one.

Productive operations commenced early in 1926 and continued until the end of 1928. During these years the scarcity of water greatly hampered progress. The plant underwent frequent alterations to increase its efficiency, but despite untiring efforts the enterprise had to be abandoned owing to shortage of water, poor recovery, and other influencing circumstances. The plant could only be termed an experimental one and Messrs. Granger Brothers are greatly to be admired for their determination in this pioneering work. Had success rewarded their enterprise, a valuable service would have been rendered to the platinum industry in this country and a very profitable one to themselves.

They expended a considerable sum of money and were also financially assisted by the Government of Southern Rhodesia.

Valuable help was given by Mr. A. M. Drummond, at that time Government Mining Engineer. The two analyses in Table 1 represent typical specimens of the "platinum reef" and the "foot-wall country" of the Wedza mine, the analyses being made by the writer at the Geological Survey Laboratory, Salisbury. Osmiridium and palladium were often reported present, but only as traces.

TABLE 1.

	Platinum reef. %	*Foot-wall country.* %
SiO_2	53·50	53·14
Al_2O_3	5·81	5·36
Fe_2O_3	2·40	2·85
FeO	8·32	6·93
MgO	22·53	22·48
CaO	4·93	4·67
Na_2O	0·21	0·18
K_2O	0·08	0·07
H_2O +	0·31	2·44
H_2O −	1·08	1·20
CO_2	nil	nil
TiO_2	0·22	0·16
P_2O_5	0·12	0·18
S.	nil	0·03
Cr_2O_3	nil	nil
MnO	0·29	0·19
NiO	nil	nil
SrO	trace	0·08
Totals	99·80	99·96
Specific gravity	3·06	3·07

ORE TREATMENT AT THE PREMIER MINE

In the *Canadian Mining and Metallurgical Bulletin* for February a complete description of milling practice at the Premier Mine, British Columbia, is given by W. J. Asselstine and D. L. Coulter, long extracts from the article being reproduced here. The authors remind us that the Premier mine and mill are situated in northern British Columbia, approximately 15 miles north of the head of Portland Canal, in the Salmon River section, about half a mile east of the Alaska-British Columbia boundary line where it crosses the Salmon River. The mill is located on a rather steep hillside on the horizon of the main haulage level of the mine and is within a 100 ft. of the mouth of the tunnel. Both the mine and mill are connected with tidewater at Stewart, B.C., by an aerial ropeway 11½ miles in length, which delivers both ore and concentrate to the bunkers at the dock for shipment to the smelters. All mine and mill supplies are transported from Stewart dock to Premier over this ropeway, except heavy machinery. Heavy pieces have to be hauled either by truck in summer or sleighs in winter over a good road which runs from Stewart dock to Premier.

When the Premier mine first came to the attention of the public, in 1918, the impression was generally gained that it was a bonanza deposit of straight shipping ore. While the first shipments were very high-grade gold-silver ore, it was early recognized by the management that in addition to the high-grade there would be a considerable tonnage of milling ore. It was, therefore, necessary to look towards a milling programme early in the mine's history.

The ore developed during the early stages of operation was highly siliceous, carrying an intimate mixture of auriferous iron-pyrite, with small percentages of zinc, lead, and copper sulphides. The predominating values were in silver and gold. The wide variation in the composition and value of the ore is illustrated by the analyses shown in Table 1.

TABLE 1.

Analyses of Premier Ore.

	Au oz.	Ag oz.	Pb %	Zn %	Cu %	Fe %	Insol. %	S %
1	0·024	14·2	0·20	—	0·015	3·6	91·1	1·65
2	0·40	14·9	0·15	—	0·005	4·8	88·1	2·90
3	0·41	5·15	2·45	—	0·28	15·2	57·6	18·05
4	0·64	20·6	0·32	—	0·025	6·8	80·7	2·85
5	1·26	28·6	0·65	1·2	—	6·3	80·3	6·50
6	1·33	42·9	0·78	1·1	—	6·1	77·3	6·30

In the preliminary tests on the ore, tabling and flotation were tried and cyaniding, both in combination with the above and straight, was also included. As a result of a great many tests, the final method adopted was to take out a fairly coarse table concentrate—high in gold—regrind the table tails, and float off as much of the gold and silver as possible, then thicken the flotation tails and cyanide them in a counter-current decantation plant. This method differed from any other commercial installation then in use and was distinctive in the feature that all grinding and flotation was done in cyanide solution. Flotation reagents used were steam-distilled pine oil, Barretts No. 634 creosote oil, and coal tar. Wilfley tables and K&K flotation machines were used in concentrating. This method was used until 1926, when cyanidation was discontinued. The development and use of chemical reagents in flotation work was receiving considerable attention at this time and experiments with various combinations of these reagents were carried out in the mill laboratory. It was found that using xanthate and steam-distilled pine oil in a circuit made slightly alkaline by the use of

sodium carbonate, recoveries were made, by tabling and flotation alone, equal to those formerly obtained by the added step of cyaniding and at a considerable saving in cost. The results were so gratifying that a month's run of the entire mill was made using the experimental method and reagents. This proved entirely satisfactory and it was decided to discontinue cyanidation.

The original mill had a maximum daily capacity of 150 tons, but when it was decided to discontinue cyaniding, another unit of 250 tons capacity was built. This was justified by additional milling ore that had been developed while opening up the mine. For approximately a year after the completion of the new unit this method of tabling and floating was followed. During this period experiments were carried on in the mill laboratory using various other combinations of chemicals and reagents. It was found that the use of a combination of aerofloat and sodium carbonate with a small amount of cyanide, in straight flotation without tabling, would give equally good recoveries as were being then made; so in 1927 the tables were cut out of the flow-sheet and straight flotation was adopted. This method has been used ever since. Table 2

TABLE 2.

Reagents Used in Straight Flotation, 1927–1931.

(In lb. per ton milled.)

Year.	No. 1 Pine Oil.	Potassium Xanthate.	Sodium Carbonate.	No. 634 Creosote.	Sodium Cyanide.	Aero-float.
1927	0·13	0·06	0·52	0·13	0·07	0·26
1928	—	—	0·40	—	0·09	0·27
1929	—	—	0·08	—	0·07	0·27
1930	—	—	0·02	—	0·03	0·28
1931	—	—	0·03	—	0·01	0·27

shows the reagents used during the period of straight flotation. From this it will be noted that there was a decided drop in the use of sodium carbonate beginning in 1929. This was due to the adoption of hydrogen-ion control in the circuit. It was found that when a *pH* value of 7·8 was maintained, the recoveries were highest. Greater *pH* value than 7·8 had no detrimental or beneficial results.

METHOD OF MILLING.—(*a*) *General Flow-Sheet.*—The ore is hauled to the mill by Edison storage-battery locomotives in trains of nine two-ton cars. The main haulage system is on the fourth level of the mine and at the same elevation as the top of the mill bins. The cars of ore were, over a period of years, weighed and a weight factor determined. This factor is checked periodically and is now used in determining mill tonnage from cars delivered. Moisture samples are taken and over a period of years the ore has averaged 2% moisture.

The mine-run ore is dumped on a grizzly, made of 80 lb. rails with 12-in. spacing, into two bins, each of 100-ton capacity—one for high-grade ore and the other for mill ore. The high-grade ore is drawn from its bin on to a 26-in. 12-ply belt conveyor, which carries it to an 18 in. by 30 in. Blake-type crusher set to 3-in. The crushed product is then elevated by a system of three conveyors to the tramway ore-bin, from which it is drawn into tram buckets and sent to the bunkers at the dock for shipment direct to smelters at either Tacoma or Anyox. The mill ore is drawn from its bin on to a 42-in. Stephens-Adamson apron feeder and is fed direct to the same 18 in. by 30 in. jaw crusher. From the jaw crusher the ore is conveyed up by a series of two inclined conveyors and discharged into a 100-ton-capacity bin. Suspended over both these conveyors are electro-magnets which remove tramp steel and iron. The ore from this bin passes over a Niagara screen with 1-in. openings. The oversize is fed direct to a No. 6 McCully Superior crusher set at 1-in. The material passing through the screen unites with the crusher discharge and is elevated by a 14 in. by 7 in. bucket elevator, which discharges against an adjustable gate so set that about two-thirds of the product from the elevator goes into a bin above the Hardinge mill, while the remainder is carried by a 20-in. conveyor to a bin above the Marcy mill.

In the original section of the mill the ore is fed by a 20-in. conveyor to a 6½ Marcy ball-mill, running in closed circuit with a 4 ft. 6 in. by 14 ft. 8 in. Model *C* Dorr classifier. This mill has

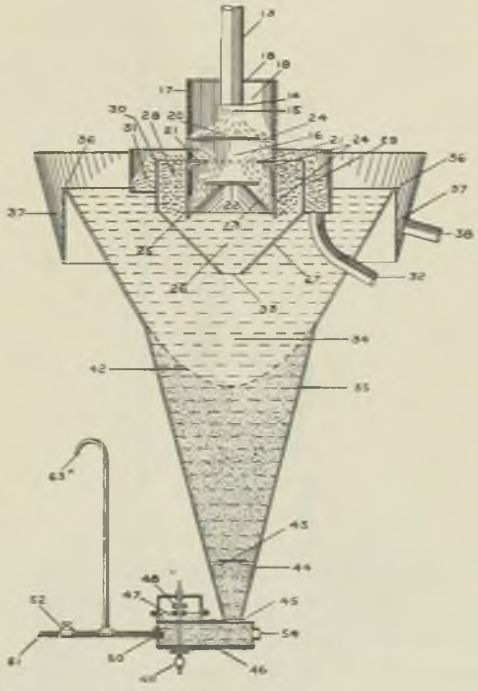


FIG. 1.

a grate discharge with ⅛-in. openings. The Dorr classifier overflow is pumped to a 4 ft. 6 in. cone with 75° side slope. This cone is equipped with a Premier flotation cell and a sand discharge box and is in closed circuit with a 4 ft. by 8 ft. regrind mill. The Premier cell, cone, and sand discharge box are illustrated in Figure 1. In the newer mill unit, the ore is fed by a 20-in. conveyor to an 8 ft. by 36 in. Hardinge ball-mill, running in closed circuit with a Model *D* 6 ft. by 20 ft. Dorr classifier. The overflow of this classifier is pumped by a 4-in. Wilfley sand pump to two 4 ft. 6 in. cones in parallel, equipped with Premier cells and sand discharge boxes, similar to those described above. The two cones, with attachments, are in closed circuit with a 5 ft. by 8 ft. Allis-Chalmers tube-mill.

The function of the Premier cell in both these Marcy and Hardinge circuits is to take out as soon as possible a coarse concentrate. The concentrate

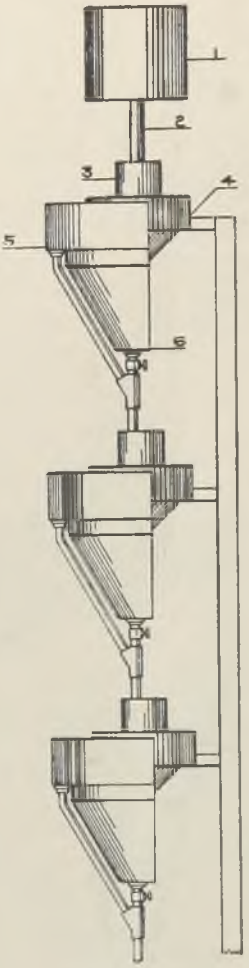


FIG. 2.

from all three of the units described above is sent by gravity to a 12-ft. K&K flotation cell where it is cleaned and sent to the finished-concentrate collecting thickener. The overflow from the cones in these two circuits passes, in each circuit, through another set of three Premier cells, arranged in series as illustrated in Figure 2. The tailing from the final cell in each circuit is sent to an 8-ft. cone arranged to discharge into a 4 ft. 6 in. Dorr classifier. This classifier is in closed circuit with a 6 ft. by 16 in. Hardinge mill. The concentrate from all six of these Premier cells is pumped up to the 12-ft. K&K cleaner cell, where it follows the same treatment as the coarser concentrate taken out earlier in the Marcy and Hardinge circuits.

The overflow of the 8-ft. cones is pumped by a 4-in. Wilfley pump to a 4-ft. surge box and distributed partly to two 12-cell 24-in. sub-aeration Mineral Separation machines in series and also to two double spitz 12-ft. K&K flotation machines in series. The concentrate from the first four cells of No. 1 M.S. machine is pumped by a 2-in. Wilfley pump to the finished concentrate collecting thickener. The froth from the remaining 8 cells of this machine joins the froth from the 12 cells of the second M.S. machine and is returned as middlings by a 2-in. Wilfley pump to both of the 4 ft. 6 in. cones above the regrind mills. This middlings product is again classified in these cones and reground. The two double spitz K&K flotation machines operate in series. The concentrate from the first machine is sent to the 12-ft. K&K cleaner-cell along with the concentrate from the Premier cells. The tailing from the first K&K machine is pumped by a 2-in. Wilfley pump and fed to the second K&K machine. The concentrate from this is returned with the middlings from the M.S. machines to the 4 ft. 6 in. cones in closed circuit with the regrind mills. The tailing from the second K&K machine joins the tailing from the second M.S. machine and is sent to waste.

The concentrate collecting tank is a 30-ft. Dorr thickener. Its discharge is delivered by a No. 4 Dorrco Simplex pump to a box feeding a 3-in. Wilfley pump. From here it is elevated by two-stage pumping, using a 3-in. and 2-in. Wilfley pump, to an 18-ft. thickener located above the tram-terminal bins. The concentrate pulp is further thickened in this 18-ft. thickener and drawn therefrom by a No. 4 Simplex Dorrco pump. The discharge of the pump is distributed to either of two Oliver filters, 5 ft. 4 in. by 6 ft. and 5 ft 4 in. by 4 ft. respectively. The filters are so situated that the cake, when discharging from the drum, drops into the concentrate bin. From this bin it is drawn by gravity into the buckets and shipped by aerial tramway to the bunkers at the dock. Lime for settling the concentrate is used at the rate of 0·3 lb. per ton of concentrate.

TABLE 3.

Metallurgical Data, Year 1931.

Head assay Au	0·305 oz.
,, ,, Ag	5·93 oz.
Total tons treated	169,760·52
Days operated: Marcy unit	345·80
,, ,, Hardinge unit	346·76
Hours operated per day	24
Operating time, per cent.: Marcy unit	95·00
,, ,, ,, Hardinge unit	95·26
Average tons milled per 24 hours: Marcy unit	176·35
,, ,, ,, Hardinge unit	290·02
Average total tons milled per 24 hours	466·37
Recovery of gold	93·35
,, ,, silver	86·29
Concentration ratio	8·44 : 1
Moisture in concentrate, per cent.	8·28
Net water consumption (Imp. gals.) per ton ore milled	700
Ball consumption, pounds per ton of ore milled	4·17
Liner ,, ,, ,, ,, ,,	0·526
Aerofloat ,, ,, ,, ,, ,,	0·280
Sodium carbonate ,, ,, ,, ,,	0·030
Cyanide (cyanamid) ,, ,, ,, ,,	0·012

(*b*) *Breaking and Crushing*.—In the original primary crushing installation there was a separate 3*D* Gates gyratory crusher installed to handle mill ore and a similar one for shipping ore. It was soon found, however, that the mine-run contained too high a percentage of ore that could not be crushed in these small gyratories; hence, it was necessary to put in, as best the contour of the hill and the mill location would permit, the 18 in. by 30 in. jaw crusher. The old mill gyratory remained in the circuit until the new mill unit was built in 1926, when a larger one—a No. 6 McCully—replaced it to serve both old and new mill units. To accommodate these changes, a series of belt conveyors had to be worked out and fitted in as best suited the existing

TABLE 4.

Detail of Grinding Mills.

	Primary Mills.		*Regrind Mills.*		
	Marcy.	Hardinge.	Denver Colorado Mill.	Allis-Chalmers Ball Granulator.	Hardinge.
Size: diameter by length	6 ft. by 4½ ft.	8 ft. by 36 in.	4 ft. by 8 ft.	5 ft. by 8 ft.	6 ft. by 16 in.
Speed, r.p.m.	25	23	31	28	27
Tons new feed per 24 hours	175	290	96	127	89
,, total feed per 24 hours	350	510	233	414	208
Type of circuit	Closed	Closed	Closed	Closed	Closed
Installed horse-power	90	150	60	75	75
Method of drive	Clutch	Tex-rope	Belt	Flex. cplg.	Tex-rope
Moisture, % in mill	20·7	23·2	24·0	24·5	23·5
,, ,, in classifier overflow	45·8	37·6	77·2	73·9	37·2
Type of feeder	Scoop	Comb. drum	Scoop	Scoop	Scoop
Ball loads, lb.	7,000	33,000	11,000	17,500	10,000
Liners, kind	Mn steel	Mn steel	Special cast-iron	Special cast-iron	Special cast-iron
Liners, lb. per ton milled	0·40	0·38	0·14	0·08	0·04
Grates, kind	Spec. Cr steel	—	—	—	—
,, lb. per ton milled	0·07	—	—	—	—
Grinding media, balls	5-in. forged steel	5-in. forged steel	2½-in. cast steel	2½-in. cast steel	1¼-in. forged steel
,, ,, lb. per ton milled	1·94	2·39	1·34	1·33	0·61
Classifier, type	Dorr Duplex	Dorr Duplex	Premier cone	Premier cones	Premier cones and Dorr Duplex
,, size	4 ft. 6 in. by 14 ft. 8 in.	6 ft. by 20 ft.	4 ft. 6 in.	2–4 ft. 6 in.	2–8 ft. and 4 ft. 6 in. by 14 ft. 8 in.
,, strokes per minute	27	27	—	—	18

units. The capacity of these two machines is governed by the character and condition of the ore produced during different seasons of the year. The heavy run-off when snows melt in the spring and during the rainy season finds its way underground and at times makes the ore very wet and sticky. This latter is responsible for the ore plugging up the gyratory in spite of the screening and it limits the tonnage crushed. During these seasons the gyratory has to be opened-up somewhat and a coarser ball-mill feed results.

(*c*) *Primary Grinding.*—As stated in the flow-sheet description, the old and the new mill units have Marcy and Hardinge mills, respectively, for primary grinding. The detail of these two installations are shown in Table 4.

(*d*) *Secondary Grinding.*—Regrinding is done by tube-mills in closed circuit with cone classifiers, and also by a 6 ft. by 16 in. Hardinge mill in closed circuit with a cone and Dorr classifier. Details of these units are also given in Table 4.

(*e*) *Flotation.*—The flow-sheet at Premier employs a stage grinding-flotation-classification system, which gives a differential grinding effect whereby the heavier sulphide particles are ground much finer than the gangue material. The development of this flow-sheet was the result of data obtained from mill operation and laboratory tests. It was found that 50 to 60% of the mineral values could be recovered when grinding to 50% – 200-mesh and the balance could be taken off as a middling product to be returned to the circuit for further classifying, grinding, and floating. By the adoption of this method, the fine grinding was decreased from 81% – 200-mesh to 70% – 200-mesh without affecting recoveries or grade of concentrate.

The Premier cell, operating with the cone classifier, was an added development of this scheme. It is illustrated in Figure 3. This cell is of the cascade type and was developed primarily for use between the primary grinding and regrind circuits and also between the regrind circuits and their respective cone classifiers. These cells remove a coarse concentrate as soon as grinding has reached the stage where flotation is possible. Besides allowing coarser grinding, the benefits from this step are :—

(1) To remove the valuable mineral from the circuit as soon as possible.

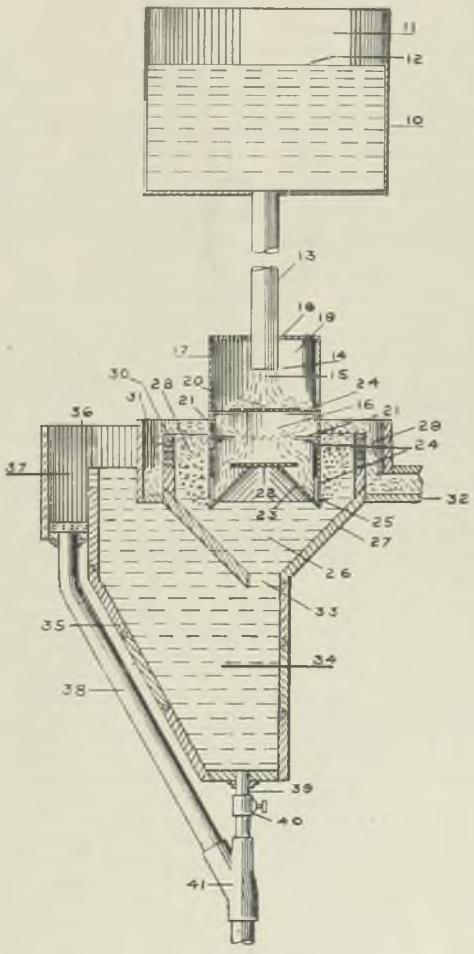


FIG. 3.

TABLE 5.

Average Mill Assays, Screen Analyses, and Recoveries, August 1 to 31, 1932.

	Weight. %	H_2O. %	Assay. Au.	Ag.	Dry Tons.	Analysis. Pb. %	Zn. %	Fe. %	Insol. %	Recovery. Au. %	Ag. %
Heads	100·0	2·0	0·35	6·55	12,782	0·4	1·6	5·8	76·0	—	—
Primary conc. from Premier cells	—	—	2·48	34·00	—	2·4	7·7	23·5	29·7	—	—
K&K cleaned primary conc.	—	—	2·92	51·12	—	2·7	8·8	27·3	13·0	—	—
M.S. conc.	—	—	2·80	60·50	—	3·1	10·5	29·8	7·6	—	—
Flot. feed to machines	—	—	0·17	4·52	—	0·2	1·9	5·1	79·5	—	—
Middlings	—	—	0·62	18·67	—	1·2	9·1	18·3	39·0	—	—
Final conc.	11·58	7·38	2·82	53·73	1,479	4·3	10·3	31·7	9·6	96·67	87·71
,, mill tailing	88·42	76·4	0·013	0·91	11,303	0·2	0·6	2·6	82·6	3·33	12·29

	+ 150-mesh. %	Au.	Ag.	+ 200-mesh. %	Au.	Ag.	− 200-mesh. %	Au.	Ag.
Final concentrate	29·6	4·47	39·26	11·4	2·96	33·92	59·0	1·92	64·80
Tailing	12·9	0·021	0·98	12·6	0·022	0·90	74·5	0·013	0·81

(2) To eliminate the peaks in the feed to the mechanical flotation machines.

(3) To produce a coarser concentrate, which in turn improves thickening and filtering.

Previous to the installation of these cells, the ore treated was ground to 81% − 200-mesh. The thickening and filtering capacity was taxed to the limit in handling the finely-ground concentrate. After the introduction of the stage grinding-flotation-classification system, the − 200-mesh material in the concentrate dropped from 88% to 60%. The capacity of the filters increased from 525 lb. per sq. ft. per 24 hours to 998 lb. Table 5 shows flotation data for the month of August, 1932.

(*f*) *Filtering.*—The required density for filtering is maintained by adjusting the Dorrco pump, which draws the concentrate from the 18-ft. thickener. It was noted that when the filter drum rotated through the pulp in the hopper a film of extremely fine material formed on the surface of the cake. This

TABLE 6.

Filtering Data.

	No. 1 Filter.	No. 2 Filter.
Filter size	5 ft. 4 in. by 4 ft.	5 ft. 4 in. by 6 ft.
Vacuum	21 in. Hg at 1,400 ft. elev.	21 in. Hg at 1,400 ft. elev.
Cloth, kind	Palma twill	Palma twill
,, average life	113 days	108 days
Average duty, tons per 24 hours	31	45
Pulp dilution	18·7% moisture	18·7% moisture
Cake moisture	8·30%	8·25%

film restricted the passage of air through the cake, thereby retarding the removal of moisture. A flapping mechanism was installed which breaks up this film and resulted in reducing the moisture from 11·3% to 10·0%. With the addition of the coarse concentrate from the recleaned product from the Premier cells, the moisture content of the filter cake showed a further reduction from 10% to 8·3%. Table 6 gives filtering data.

(*g*) *Sampling.*—The mill-head sample is taken by Galigher automatic samplers, cutting the overflow of the primary classifiers at seven-minute intervals. This gives a very accurate sample of the ore actually milled as it is taken when grinding has proceeded sufficiently to permit a true sampling. The main tailing launder is equipped with a similar automatic sampler which takes the mill-tailing sample. A cut of the stream is made at seven-minute intervals.

TABLE 7.

Summary of Power Consumption, Year 1931.

Tons Treated, 169,760.

	Kilowatt Hours.	Kilowatt Hours. Per Ton.	Per cent. of Total Power.
Primary breaking	236,444	1·393	4·46
Secondary breaking	396,027	2·333	7·47
Primary grinding	1,211,681	7·138	22·84
Secondary grinding	972,008	5·726	18·32
Classification	76,562	0·451	1·44
Flotation	1,038,584	6·118	19·58
Filtering	213,044	1·255	4·02
Pumps	991,980	5·843	18·70
Lighting	168,120	0·990	3·17
Total	5,304,450	31·247	100·00

The grab samples of shipping concentrate are taken during the loading of each tramway bucket. These buckets carry approximately 1,050 lb. each. Over a period of years, the results obtained by this method have checked remarkably closely with the actual smelter assays. All intermediate samples are

TABLE 8.

Summary of Costs, Year 1931 (per ton ore milled).

Tons treated: 169,760. Production: 48,389 oz. Au, 868,371 oz. Ag.

	Operating. Labour.	Power.	Supplies.	Repairs. Labour.	Supplies.	Total.
Primary breaking	·028	0·13	—	·024	·027	·092
Secondary breaking	·030	·019	—	·008	·013	·070
Primary grinding	·035	·070	·137	·026	·104	·337
Secondary grinding		·055	—	·010	·018	·118
Classification		·004	—	·003	·003	·010
Flotation plant	·032	·050	—	·020	·019	·121
Reagents	—	—	·059	—	—	·059
Filtering	·033	·010	—	·004	·004	·051
Pumps, pipe-lines, and launders	—	·047	—	·013	·030	·090
Oils, waste, and grease	—	—	·009	—	—	·009
Small tools	—	—	·002	—	—	·002
Motors, wiring, and lights	—	—	—	·007	·006	·013
Lighting	—	·006	·002	—	—	·008
Heating	—	—	·008	—	—	·008
Experimental	·009	—	—	—	—	·009
Building repairs	—	—	—	·003	·003	·006
Superintendence	·064	—	—	—	—	·064
Totals	·231	·274	·217	·118	·227	1·067

taken by hand. All samples are 24-hr. samples and are collected at 10 p.m. The assays from these samples are available the following day at 1.30 p.m.

(*h*) *Reagents.*—Cyanamid and soda-ash are mixed dry and fed by a reconditioned Merrill zinc-feeder to the ore at the gyratory crusher. Aerofloat No. 15 is fed by mechanical feeders to all grinding units.

(*i*) *Water Supply.*—The freshwater supply is obtained entirely from the mine. The water flows from the upper mine workings to the mill supply tank. The mine water contains no substance injurious to flotation and has a *pH* value of 7·2. The approximate yearly average temperature of this water is 36°.

POWER.—All machinery is run by motors, power for which is supplied from the Company's own plant, situated on Cascade Creek, half-a-mile below the mill. The plant consists of six Fairbanks-Morse Diesel engines with a total combined h.p. of 1,680 ; also one 3-runner low-head Pelton wheel of 550 h.p. ; and two single-runner high-head Pelton wheels with a combined h.p. of 550. During the summer months power is generated by the hydro-electric plant ; during the winter, owing to the lack of water, the Diesel engines are used. Power is generated and transmitted at 2,300 volts and is stepped-down for some of the motors to 440 volts and for lighting to 110 volts.

HEMATITE IN SIERRA LEONE

In *Economic Geology* for January–February, 1933, K. Fowler-Lunn, who has spent the past two winters doing geological work in the central part of Sierra Leone, where large deposits of high-grade hematite have recently been found, gives an account of the hematite iron ores of Sierra Leone. The natives in previous generations smelted iron ore throughout Sierra Leone but they are not only loath to tell the sources of the iron used but appear to have forgotten the art of making steel. In consequence of the findings of high-grade banded ironstones in three places in the central schist belt, or Kambui schists, of Sierra Leone (at Sakasakala, Keimadugu, Sokoya, and Nerekoro) the Government closed to prospecting a large area in which the hematite occurred. It was through the suggestion of Major Junner that the author undertook the mapping of the continuation of the hematite deposits in 1931, the Government of Sierra Leone contributing a sum towards expenses. The deposits proved much larger and richer than anticipated, so that the Government has continued to keep the area closed, and will eventually give development rights to some commercial company willing to exploit the ore. The problems concerning the origin of the hematite deposits, and the geological history of the range in which they occur, have been followed up independently by the author through traverses of the range and the study of thin sections. They were also constantly borne in mind during the past year while geological investigation was being carried on for a gold mining concern (Maroc, Ltd.) in other parts of the same crystalline belt, continuations of the same hematite deposits having been encountered far to the south of those originally mapped.

GENERAL GEOLOGY OF SIERRA LEONE.—Sierra Leone consists of a low-lying coastal plain about 100 miles in width, back of which is a hilly to mountainous region, a semi-plateau, from which higher mountains rise. Freetown and its environs are made up of a mountainous mass of norite, gabbro, and anorthosite. Elsewhere, great belts of ancient schists stretch across Sierra Leone, cut off from one another by intrusive granites. The age relationship of these " roof pendants " of schist has not been determined. In French Guinea to the north rocks containing Silurian fossils overlap the schist-granite belt, marking the age of the Sierra Leone rocks as pre-Silurian. The hematite deposits under discussion are situated about in the centre of Sierra Leone in the belt of Kambui schists. A provisional geological map of Sierra Leone and a full account of the geology and mineral resources by Dr. N. R. Junner appeared in the MAGAZINE for February, 1930.

Physiography.—The mountainous region in which the hematite deposits occur is slightly higher than the surrounding granites, owing to the resistance to erosion of the Kambui schists. The drainage has been superposed from an earlier erosion cycle, so that some of the larger streams cut across the structure of the mountain mass at right-angles. The granites to the east and west form a plateau topography, capped by domes or " inselbergs," in contrast to the rough, jagged dissection of the schist region, whose hills follow the north–south strike of the steeply-dipping rocks. The hematite deposits are only 110 to 130 miles from the coast, so that a railroad could be readily constructed across the coastal plain belt, thence through the gorges of the superposed streams, directly to the iron formations.

Rock Formations.—The determination of the geology of this region is difficult on account of dense forests and a superficial covering of laterite and thick soil. However, the hematite is more resistant than the other parts of the formation, producing hills and ridges that are dissected by several transverse stream valleys. Sections along these streams permit the approximate delimitation of the hematite, even though the actual contacts are seldom visible.

The schist belt in which the hematites occur is about 50 miles long, with an average width of 10 miles. Various rocks are found, ranging from hematite to banded ironstones, sandstones, quartzites, conglomerates, hornblende schists, mica-, talc-, and chlorite-schists, fine- and coarse-grained amphibolites, as well as schists of intermediate types and questionable origin. Some of the formations are of sedimentary origin ; others are possibly old volcanics or highly metamorphosed basic intrusives with obscure history. These rocks now stand vertically, or dip steeply, to the east. The schists show various effects of the granite intrusives. Some appear to have been impervious, while others were invaded and metamorphosed by the end stage differentiates of the granite, consisting of tourmaline, pegmatites, and auriferous quartz veins.

HEMATITE.—In the northern part of the schist belt there is one main bed of hard, massive, blue to brick-red, banded hematite which has been traced for a distance of twelve to fifteen miles, showing an average width of 1,000 ft. The actual contacts have not been observed but streams have cut into the banded hematites across the strike, revealing cliffs of ore up to sixty feet in height. The width of the surface float is considerable in places. Also

the height from the tops of the ridges of hematite to the bottoms of the stream beds where iron ore is exposed is as much as 500 ft., suggesting that the iron ore should have considerable continuance in depth. There appears to be no change in the character of the ore from the highest to the lowest points. No drilling has been done to date and, since the work has been necessarily of a reconnaissance nature, only a rough estimate of the enormous mass of this main ore bed can be made, the figures running far into the millions of tons.

In addition to the main deposit there are four smaller parallel beds of hematite. These have not been as easy to trace but are of equally high grade. Banded ironstones of lower grade are found towards the southern and western side of the schist belt. There is evidence that the high-grade iron formations are continuous, perhaps intermittently, throughout the entire length of the schists, for areas of rich ore are found in several places many miles to the south of the main deposits, one place in particular having been encountered where high-grade ore outcrops for over a mile along a traverse line. This is only one of many indications that the hematite is even more extensive than was revealed by the mapping of the main beds to the north.

Analyses.—From the specimens collected for thin sectioning and geological study the Government of Sierra Leone had 38 chemical analyses made by the Imperial Institute in London. These analyses show that the iron ore runs consistently high in iron oxide : 80% to 90%. Alumina is low, averaging from 1% to 3%, except in the lateritic samples. Silica rarely exceeds 3%, except in the specimens of the siliceous banded ore. Manganese is mostly less than 0·1%, titania averages 0·1%, and sulphur runs around 0·03%. Phosphorus is the only questionable impurity ; some of the ores are of Bessemer grade, and others are over the Bessemer limit. The variable phosphorus content may be explained by the fact that the specimens were collected at the surface, and not primarily for mining determinations.

Origin of the Hematite.—Since contacts between the hematite and the surrounding rocks are poor and indistinct and the sections so far studied have given few clues to the history of the iron ore the author considers it best at this point merely to list the possibilities of origin of the ore, without going into detail. It is hoped that further work in the ore belt, together with their development will clear up some questionable points.

Possibilities of Origin of Sierra Leone Hematite.—

(1) Original rocks were lean iron ore formations interbedded with lava flows.

(*a*) Secondary enrichment of lean ore by weathering.

(*b*) Secondary enrichment of lean ore by basic dikes or other intrusives.

(2) Original rocks were lean iron ores bounded by intrusive basic sills.

(*a*) Secondary enrichment of lean ore by weathering.

(*b*) Secondary enrichment of lean ore by emanations from the basic sills at the time of intrusion.

(*c*) Secondary enrichment by later basic dikes or other intrusives.

(3) Original rocks were sedimentary formations, possibly sandstones, replaced by iron oxide with or without secondary enrichment.

(4) Original rocks were basic igneous formations, later replaced by iron ore, with all the possibilities of enrichment listed above.

Although it may be presumptuous to discuss the possibilities of origin of the hematite with the limited data now at hand, it seems as if some of the possibilities listed can quickly be eliminated. The chemical analyses made from the siliceous phases of the iron formation show that the amount of alumina is the same in the high-grade ore as in the sandy phases. This would appear to eliminate No. 4, for if the original rock has been igneous, there should be a higher percentage of alumina in the low-grade ore. Also, in one place, the hematite grades into a sandstone, and highly siliceous banded ironstones are found not far from the iron ores, indicating a sedimentary origin of the original bed.

If interbedded lavas or later intrusives and their emanations had been the main cause of the enrichment, it would be expected that the analyses would show higher titania, phosphorus, and sulphur—at least in the low-grade ores. The basic intrusive rocks in the vicinity carry variable amounts of pyrite and end-stage quartz veins associated with the granite carry tourmaline and commonly pyrite and gold. None of these rocks have been seen to permeate the hematite. Possibly the hematite may have proved impervious to them, for the analyses do not appear to carry expectable elements that are associated with these later intrusives. The amphibolitic rocks, commonly found on both sides of the hematite but never in actual contact with it, are so recrystallized that their origin is uncertain. They may have been intrusive sills or lavas. They are cut by later coarse-grained amphibolitic rocks, as well as by the quartz veins and pegmatites associated with the granite.

The fact that the hematite is a continuous formation, paralleling sandstones, banded ironstones, and coarse conglomerates indicates a probable sedimentary origin of the original iron-ore formation. The presence of conglomerate adds the possibility of an erosion interval during an early phase of the history of the ore, and secondary enrichment by weathering processes before the beds reached their present position. It is difficult to visualize secondary enrichment to the necessary depth under present conditions, since the near by rocks of sandy character have not been affected, and many of the adjoining amphibolitic rocks are absolutely fresh. Lateritization of the rocks on the surface rarely exceeds 25 ft. ; however, a sandy bed could have been permeable to greater depths.

The simplest explanation of the origin of the ore seems to be secondary enrichment of a lean ore formation when the original beds were in a more nearly horizontal position. An early erosion surface is represented by the conglomerate interbedded with the sandstones and banded ironstones. Later enrichment may also have occurred. This conclusion is merely a temporary working hypothesis, since there are many other factors, impossible to determine with the scanty evidence now at hand, that may have entered into the process of enrichment.

Conclusion.—The hematites of the central schist belt of Sierra Leone are deposits worthy of economic attention, since they represent high-grade iron-ore reserves running into many millions of tons. They are easy of access, but are as yet absolutely undeveloped. The problems in connection with their origin are of unusual interest.

MINERAGRAPHY

A report entitled "Mineragraphy or the Petrology of Ores and its Economic Significance," prepared by Dr. F. L. Stillwell for the Mineragraphic Investigations Committee of the Australian Commonwealth Council for Scientific and Industrial Research, is reproduced in the *Chemical Engineering and Mining Review* of Melbourne for January 5 and full extracts from it are given here. The author says that mineragraphy is a coined term to signify the field of microscopic investigation of ore minerals. The term is not euphonius and is sometimes regarded as superfluous because the subject is no more than an enlargement of the scope of petrology. In the past the practical field of petrology has been largely limited by the instruments which were designed for the study of rocks and the microscopical properties of the transparent minerals. The addition of mineragraphy has been brought about by the use of the reflecting microscope and a totally different technique.

The use of the petrological microscope, as it has been employed in the training of geologists and mining engineers for nearly half a century, has been justified many times, not only in its application to general geological problems, but also in the more restricted field of the exploration and examination of ore deposits. It provides information of the gangue minerals and rocks associated with an ore-body which is of great value in some mining fields. In cases where ore deposits occur selectively in certain favourable types of rock the recognition and delineation of these rock types is a useful guide in prospecting. The Boulder Belt at Kalgoorlie forms one of the most striking examples in Australia where important significance is attached to different rock types and the petrological microscope is essential to their elucidation. Here the ore-bodies occur in a favourable quartz-dolerite greenstone and the unfavourable rock types, known as epidorite and calc-schist, can sometimes be distinguished only with the help of the microscopical characters. The microscope is also necessary to trace the mineralogical changes that occur in the favourable rocks by processes which are allied to those that form the ore. At Kalgoorlie the differences between quartz-dolerite greenstone and the bleached greenstone may be striking to the naked eye on account of the mineralogical changes, but they are relatively unimportant in comparison with the differences between bleached greenstone, altered porphyrite, and calc-schist. These three rock types are geologically different, but may often be easily confused until rock sections are prepared and examined with the petrological microscope.

The educational value of the petrological microscope in the training of the mining engineer and geologist lies not so much in the degree of skill acquired in its use as in the enlarged vision that is obtained of the realm of minerals and rocks and the properties and structures relating thereto. Its chief practical value for the engineer engaged in the examination of an ore deposit has been the understanding that can be given to the essential and unessential details. It is not often possible, or even desirable, for an engineer to carry a microscope with him into the field but the man who has once studied rocks in the minute detail that is possible in rock sections acquires an enlightened attitude which he is always able to carry with him and which often enables him to recognize at a glance types which, for one reason or another, are puzzling to the less-practised eye.

The reflecting microscope, by which mineragraphy has developed, is just as important for eduction and research in its special sphere as the petrological microscope is in the realm of the transparent minerals. It widens the field of observations on the ore minerals which, while fewer in number than the rock-forming minerals, are of much greater concern to the miner and metallurgist. The opaque minerals may be determined with the same facility and accuracy as the transparent minerals are with the petrological microscope. The size of the grain or texture of the minerals may be measured by using a micrometer ocular; the manner in which various minerals are intergrown may be observed and in many cases the order in which the minerals have been deposited may be worked out. Minerals of secondary origin may often be distinguished from others by their mode of occurrence. Mineral changes are also sometimes revealed which signify events during the development of the ore-bodies and which would otherwise be quite unsuspected.

The technique that is employed in the preparation of polished surfaces for examination in reflected light and in the methods for the diagnosis of different minerals, even under high powers of magnification, has shown rapid development. It is described in the following three manuals which were issued in 1931 none of which use the term mineragraphy as the subject title: "The Microscopic Determination of the Ore Minerals," by M. N. Short, appeared as Bulletin 825 of the U.S.A. Geological Survey; "The Determination of the Opaque Minerals," by C. M. Farnham, was published in book form in America; while the "Lehrbuch der Erzmikroscopie," by H. Schneiderhohn and P. Ramdohr, was published in Germany. The last is a volume of over 700 pages and its bibliography of 618 papers is an illustration of the wealth of material that is now available for study.

The methods can be adapted to the study of concentrates and other mill products. The crushed material is mixed with a suitable medium to form a briquette, which is then ground and polished in the same way as solid ore. The metallurgist, once trained, has then the power of examining the mineral content of each product in the mill and ascertaining more information than is signified by a simple assay.

In all large-scale mining operations the aggregate value of unrecovered metals is large and it is ever the task of the mining engineer and metallurgist economically to improve the recoveries and reduce the losses of the valuable minerals. Whether this is to be achieved by variations in the degree of fineness to which the ore is crushed, or by variation in the method of treatment, depends on the inherent characteristics of the ore. The ultimate basis for advancement is an accurate knowledge of the detailed mineral constitution and mineral associations of the complex ore. Assay values alone are insufficient, since they do not tell the chemical combinations of the valuable metal, the size of the individual particles, or the particular mineral or combination which causes a valuable element to escape the concentrating table or flotation box. Further, the detailed knowledge of the mineral constitution of potential ores becomes an enormous

advantage in the application of trial treatments in comparison with the " hit or miss " experimental work by which many treatment processes have been developed in the past.

The mineragraphic examination of the Broken Hill ore revealed the presence of 16 primary sulphides as well as many interesting relationships between them. Ten of these, including three primary silver minerals, had not been previously recognized in the Broken Hill lode. The inherent occurrence of microscopical silver minerals, separable from the zinc blende and galena, is an important fact utilized in preferential flotation. The development of preferential flotation at Broken Hill and the consequent transfer of lead and silver, formerly contaminating the zinc concentrates and for which the Broken Hill mines were not paid, into the lead concentrates where it is paid for, has resulted in great financial benefit to the Broken Hill companies. It can be justifiably claimed that the present efficiency in recoveries at Broken Hill would have been more quickly attained if mineragraphic studies had been available at an earlier date.

Gold in the complex ore of Rosebery, Tasmania, provides an illustration of important peculiarities of occurrence that may be discovered by microscopical observations. The zinc-lead ore of Rosebery averages 2·12 dwt. of gold per ton and a microscopical examination shows that not only are some of the gold particles extraordinarily minute but that the mineral tetrahedrite, which occurs mostly in particles of microscopical size, is the common host for them. It indicates that a study of the behaviour of tetrahedrite throughout the treatment processes is a pre-requisite for experiments directed towards improved recoveries in gold as well as silver.

The scientific value of microscopic observations on concentrates, tailings, slags, and other products of ore treatments is less than similar observations on crude ore because the individual particles are largely divorced from associated minerals. At the same time their economic bearing is more direct. The microscopical detection of a silver mineral in the tailings at the Pinnacles mine at Broken Hill was sufficient to explain why high losses in silver (up to 10% of the average silver values of the concentrates) occurred at one time in the concentration of high-grade galena from this mine. The detection of composite particles consisting partly of chalcopyrite and partly of quartz in tailings from the treatment of copper ore, which had been crushed to pass through 50-mesh, is convincing evidence that finer grinding will improve recoveries. The discovery and illustration of consolidated globules of copper matte in a blast furnace slag from Mt. Lyell, as in Fig. 2, adequately accounts for the small copper percentage present in the slag.

The extension of microscopical observations to polished surfaces of roasted concentrates from Wiluna leads to the possibility that recoveries may be improved by a closer control of roasting conditions. The purpose of roasting pyritic concentrates, prior to cyanidation for gold, is first to change deleterious sulphides into innocuous oxides and secondly to chemically disintegrate particles of sulphide which may enclose particles of gold. The extent to which roasting does not disintegrate individual particles and to which it produces hard pseudomorphs of iron oxides is a measure of the ineffectiveness of the roast and can be followed by microscopical observations.

Such examples of the utility of microscopical observations with the reflecting microscope stimulate its application in research and justify its incorporation in the courses of petrological training of mining and metallurgical engineers.

SKIP CAPACITIES

In the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for December, 1932, some notes on the measurement of skip capacities are given by A. Clemes. The author says that in a paper appearing in the same *Journal* for March, 1932, L. Bok, in discussing the " Water Problem of the East Rand Proprietary Mines," gave certain figures applying to the moisture hoisted with the rock in wet shafts. The author says that for the purpose of determining rock loads on winders it is obvious that the allowance for water should be based on a figure more nearly approximating the maximum to be met with than the average condition. Where, however, skip and car factors are employed extensively as one means of arriving at tons mined and milled, the value of such computations depends on determining within the closest possible limits the sum of all factors having bearing on the problem.

In view of the importance of this question the results are given of some skip capacity determinations undertaken at East Geduld mine some few months ago. The skips at this mine are rated 7·5 tons capacity at 20 cu. ft. to the ton and are loaded by the usual type of measuring bins at the shaft station. The latter have been carefully checked for size and are filled as accurately as possible to the correct level. In practice, however, the tonnage delivered to the mill is found to deviate appreciably from the tonnage as determined in the slimes plant and steps were taken to check the skip factor. At first it was attempted to do this by measurement of skips, the load being calculated from the usual figure of one ton per 20 cu. ft. Very little information was obtained in this manner as results were erratic and it was decided actually to weigh the contents of some skips.

Ten skips, five from each compartment, were raised to the collar of the shaft and a pan placed underneath to catch water percolating through from the rock and liberated through two holes in the skip bottom. Each skip was then treated as follows: The contour of the " load-line " was obtained by means of offsets from the skip top; the load was then levelled off by shovelling and further measurements taken. This gave two independent sets of figures from which to calculate the cubic feet occupied by the rock. After this the ore was shovelled out and weighed on a one-ton scale, large portions being removed from time to time for moisture determinations. To the percentage moisture so obtained was added any drip accumulated in the pan. Plus and minus three-quarter inch gradings were also carried out on the material used for the moisture samples, but these were not sufficient to indicate any correlation between rock size and volume per unit weight. Results from these

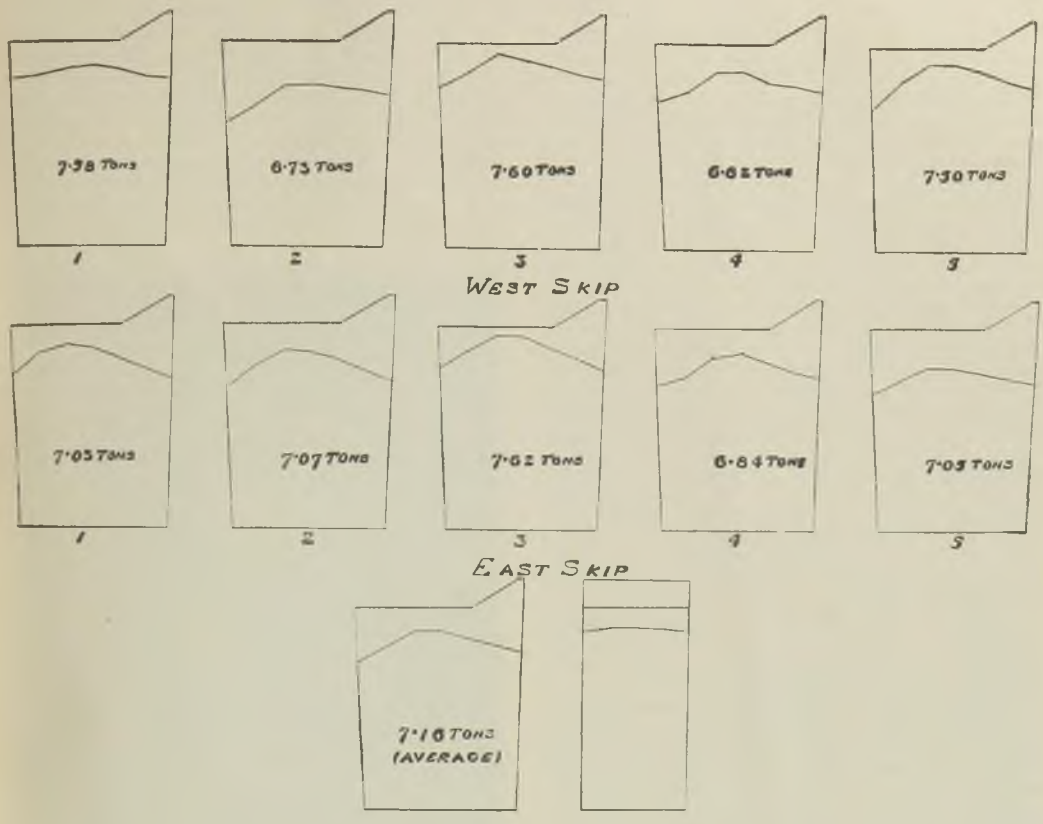


FIG. 1.—ROCK-LOAD CONTOUR OF TEN SKIPS WEIGHED.

measurements and weighings are given in Table 1 and cross-sectional diagrams in Fig. 1.

It will be seen that the moisture content of the ore averaged approximately 4% on the dry weight hoisted. By means of raising an empty skip with the holes in the bottom plugged it was found that the amount of water added to the rock in its trip through the shaft accounts for approximately 0·07% of the above moisture—a figure which could be used to indicate the wetness of the shaft.

The discrepancy discovered between the commonly accepted factor of 20 cu. ft. per ton of dry ore and the actual figure of 18·9 arrived at from the average measurements and weights of the ten skips is of the order of 5%. Moreover, the latter figure was found to vary between individual skips by as much as 10%, due to variation in size and shape of rock, conditions of loading, and perhaps acceleration and "bumping" effects during hoisting. In addition the load-line contours were found to differ widely in shape from similar reasons. So that the computation of skip tonnage from mere cubic capacity calculations would be quite unreliable except when averaged over a great number of skips. More particularly is this the case on the East Rand, where the rock breaks into irregularly shaped slabs.

From these results it would appear that, except where it would be practicable to interrupt hoisting at regular intervals over a long period of time and obtain very extensive data of actual skip-loads, the acceptance of a skip factor for tonnage determinations is subject to short period inaccuracies greater than that normally tolerated in the final stages of metal or mineral recovery.

TABLE 1.

Skip Measurements at the East Geduld Mine.

Skip No.	*Volume occupied by rock: cubic feet.*	*Weight of dry ore: tons.*	*Cubic feet per ton of dry ore.*	*Moisture as per cent. of dry weight.*
West 1	138·796	7·584	18·301	4·25
2	122·484	6·725	18·210	6·18
3	145·938	7·600	19·202	3·33
4	131·629	6·618	19·889	3·02
5	139·883	7·501	18·650	3·63
Averages	135·783	7·206	18·843	4·05
East 1	137·620	7·031	19·570	1·93
2	132·397	7·069	18·730	4·56
3	144·944	7·615	19·034	3·57
4	131·623	6·835	19·257	3·80
5	125·873	7·053	17·846	3·86
Averages	134·589	7·121	18·900	3·54
Average of Ten	135·186	7·164	18·870	3·80

NOTE.—Moistures are given as per cent. of dry weight to correspond with those shown in Mr. Bok's paper.

AN AUTOMATIC-DUMPING CAGE

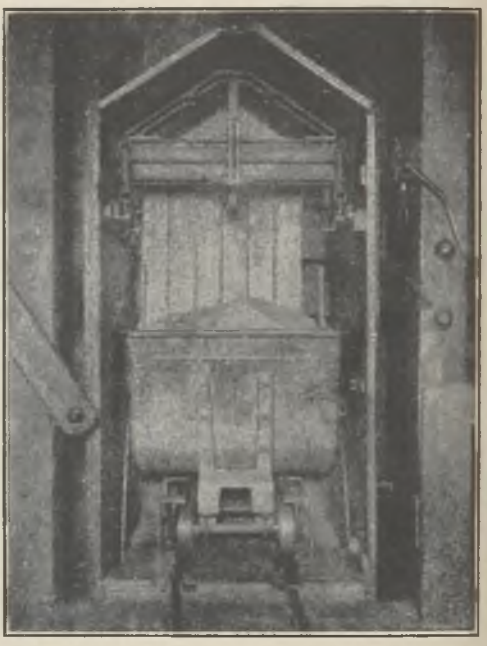
A description of a self-dumping cage which combines the features of a small skip and cage is given by L. G. Morrell in the *Canadian Mining and Metallurgical Bulletin* for February. The author says that such a cage has been used in a vertical winze between the 2,000-ft. and 2,500-ft. levels at the Coniaurum mine for the past three years, during which time its success has been demonstrated by uninterrupted service and low maintenance charges. It was designed by John Reddington, mine manager, and was built under his supervision in the Coniaurum mine shops. Being new in many of its operating features a small-scale model was made and tried before the final construction was undertaken. The mechanical performance of the model suggested a few minor changes that were incorporated in the final drawings. During its three years of use the automatic dumping device has saved the expense of deck-handling of the cars. This actually represents a gross economy of something over four times the cost of construction and installation, which totalled $1,325. The cage, empty, weighs 2,200 lb., of which 500 lb. represents the weight of the dumping accessory and necessarily heavier construction. Besides a considerable financial saving the time saved in unloading increases the daily hoisting capacity of the winze. In raising ore from the 2,500-ft. level five minutes is required for a complete trip. Allowing one minute for the alternative of decking it is believed that the automatic dumping has increased the capacity of the winze hoist nearly 20%.

Construction Details.—The main support structure consists of four 3 in. by $\frac{3}{8}$ in. iron bars suspended between the two cam-shafts and two shafts across the bottom of the cage. The cam-shafts, in turn, are supported by a cross-head member made up of two 8 in. by 2 in. by $\frac{1}{2}$ in. channels. Walls and hood are $\frac{1}{8}$ in. and $\frac{3}{16}$ in. plate, respectively, riveted to $1\frac{1}{4}$ in. by $\frac{1}{4}$ in. reinforcing strips along the edges. The floor is 2 in. planking laid on a frame of $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $\frac{1}{4}$ in. angle-iron.

The dumping frame consists of a flat L-shaped arrangement with the ends braced by 3 in. by $\frac{1}{4}$ in. bars bent into the shape of a quarter-circle. U-shaped guards of angle-iron, long enough to extend around both the front and rear wheels of the car, act as track on the cage floor and hold the car when it is being dumped. To prevent the car from rolling a hinged hasp-type lock on the quarter-circle member slips over a corresponding ring on the body of the car and a locking pin is dropped through the ring. This device can be seen in the accompanying figure at the right-hand side of the car.

Normally the dumping frame forms part of the floor and back wall of the cage. A 2-in.-square shaft across the top of the wall portion extends beyond the side walls and rollers are attached at the ends. As these rollers engage the dumping guides the dumping frame revolves on bearings at the bottom of the cage and the load is dumped into a bin. When the cage is lowered the dump-guides lead the rollers back to their normal position and the floor and wall drop back into place.

A safety lock is provided to prevent the dumping frame from accidentally swinging out at any time except when the cage is actually ready to dump. It consists of an obtuse-angle lever pivoted on a hub through the wall, near the bottom of the cage. At one end a shoe is suspended over the rising end of the floor until a small roller, at the other end, is forced toward the centre of the winze by engaging an offset parallel runner fastened to the timber at the dumping height. So on the upward trip just before the dump-rollers engage their guides the shoe is swung clear of the end of the floor; and on the down-trip the shoe is swung back over the floor as soon as the small roller leaves the runner.



Automatic-Dumping Cage, Coniaurum Mine.

For hoisting and lowering men a four-section folding door, which is ordinarily folded into a recess in the wall, is expanded across the front of the cage and a removable iron panel is placed above the dumping frame at the back. Thus converted, the cage is completely enclosed to a height of $5\frac{1}{2}$ ft. The permanently fixed wheel-guards obstruct the floor but cause no inconvenience.

The one-ton cars used as standard throughout the mine are of round-bottom, side-dump type. Several of these were altered for use in the self-dumping cage by rigidly fastening the bodies at right-angles to the wheels on chasses of 4 in. by 6 in. timber. This alteration in no way impairs their usefulness for filling or tramming.

Potassium Ferrocyanide as a Coagulant.—Some observations by C. T. Creed and C. F. Cayton-Boxall on the use of potassium ferrocyanide as a coagulant in the assay of gold-bearing solutions and in the treatment of slimes residues for total gold assay are given in the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for December last. The authors state that the erratic values occurring in slimes residues, especially

in those obtained from the decantation process, were the cause of the investigation. They say that the copper methods of precipitating gold from gold-bearing cyanide solutions are in general use in assay offices on the Witwatersrand ; the cuprous chloride method being especially favoured because of easy and rapid manipulation. These methods are detailed in : "Rand Metallurgical Practice," in "Rand Assay Practice," in Parks' "Cyanide Process," and in Clennell's "Chemistry of Cyanide Solutions." Clennell states : "In the assay of solutions by the copper method, the presence of ferrocyanide, shown by a brown chocolate precipitate of copper ferrocyanide, is advantageous. The effect of the ferrocyanide is entirely mechanical, the gelatinous precipitate acting as a very perfect filter. Although the copper method gives slightly lower results than those obtained by evaporation, the error is least in the presence of a good excess of ferrocyanide."

From experiments carried out upon gold-bearing cyanide solutions and slimes residues it was found that the use of excess ferrocyanide caused part of the gold precipitated by the copper to be re-dissolved, and to pass off in the filtrates. T. K. Rose, in the "Metallurgy of Gold," states that ferrocyanide dissolves gold. Experiments were carried out using both the cuprous chloride and the copper sulphate-sulphur dioxide methods upon gold-bearing cyanide solutions, and in the treatment of slimes residues for total gold, and these showed that the use of ferrocyanide is not necessary, the slime acting as an efficient catching medium for the precipitated gold ; also that ferrocyanide used in excess leads to loss of gold into the filtrate.

In the treatment of slime residues for total gold by the copper sulphate-sulphur dioxide method, experiments showed that as in the case of the cuprous chloride method, the use of ferrocyanide is not necessary, the slime acting as an efficient catching medium for the precipitated gold, and that ferrocyanide used in excess leads to loss of gold into the filtrate.

Further tests in the assay of gold-bearing cyanide solution by the cuprous chloride method indicated that a few drops, not more than 1 c.c., of a 5% solution of ferrocyanide, is all that is necessary, the use of excess ferrocyanide leading to loss of gold into the filtrate. While in the assay of gold-bearing cyanide solutions by the copper sulphate-sulphur dioxide method, it appears that, as in the case of the cuprous chloride method, only a few drops of ferrocyanide are required, the use of excess ferrocyanide leading to loss of gold into the filtrate. All filtrates from the above series of tests were assayed by the evaporation method.

The possibility of the ferrocyanide reacting with the cuprous chloride or copper sulphate, and thereby interfering with the precipitation of the gold, was next investigated. In the experiments carried out, the copper salt was in contact with the sample for 30 minutes before the ferrocyanide was added, and indicated that upon the addition of the ferrocyanide part of the gold precipitated by the copper salt was actually redissolved.

The authors state that the following method will be found to give reliable results in the treatment of slime residues for total gold.

Cuprous Chloride Method.—Place 1,500 to 2,000 c.c. of well mixed slime pulp, thinned down to 1·40 specific gravity, in an enamel bucket or Winchester quart bottle. Add 15 c.c. of well reduced cuprous chloride solution and agitate thoroughly for at least 10 minutes. Press off the liquor and dry the residue in an enamel dish. Pass the dried sample through a 900-mesh screen to break up any lumps, mix well, and sample for assay.

Gold in North-Western Quebec.—The rapid development of the gold fields of north-western Quebec was one of the outstanding events in the Canadian mining industry during 1931 according to a report by A. Buisson of the Department of Mines, Ottawa. The gold deposits of this district occur, for the most part, throughout a zone extending from the Ontario-Quebec boundary eastward for a known distance of about 120 miles. This long stretch of territory now contains five producing mines, the Noranda, Granada, O'Brien-Cadillac, Siscoe, and Bussieres, one property, the Beattie, which is nearing the production stage, and several promising properties, which are being actively developed. Noranda first attained prominence as a copper producer but is now also well to the forefront as a producer of gold. The output in recent months has been at the rate of about 30,000 tons of copper and about $8,000,000 in gold annually, the latter figure being exclusive of exchange. The capacity of the Noranda concentrator is being increased from 1,000 to 2,000 tons of ore a day, so that by the end of the year the mine will have a daily production of about 4,100 tons of ore. The Granada, about five miles south of Noranda, has been developed to a depth of 1,225 ft. and additions to the mill have increased its daily capacity to 100 tons of ore. The deposits are quartz veins in sedimentary rocks. The O'Brien-Cadillac mine, in Cadillac township, has been producing intermittently for several years, making occasional shipments of high-grade ore. A new 150-ton mill is now in operation. The Siscoe mine, on Siscoe Island, about 55 miles east of Noranda, is developed to a depth of 1,000 ft. and the mill is now treating about 175 tons of ore a day. The gold output for 1932 will exceed one million dollars, exclusive of exchange. The deposits consist of auriferous quartz tourmaline veins, in a stock of granodiorite. The Bussieres property, owned by the Treadwell-Yukon Company, Limited, is situated in the north-west corner of Louvicourt township. Surface trenching and diamond drilling conducted in 1931 indicated some very favourable conditions. Development operations were started in the autumn of that year and the operators have already opened the mine to a depth of 700 ft., completed all the necessary camp buildings, including a 200-ton mill and a power plant, and have erected an eleven-mile power transmission line. A five-mile light railway for supplies has also been completed.

At the Beattie mine, in Duparquet township, a large, low-grade gold deposit has been proved by underground work and by diamond drilling. The necessary buildings for mining operations have been completed, a new four-compartment shaft is being sunk, and the erection of a 600-ton mill is under way. The capacity of the mill will be gradually increased as the development of the mine progresses. Other important developments in western Quebec include promising underground work at Beaufor mine ; extensive surface work on the Ventures claims and at the Matthews property in Pascalis township ; surface work which has shown interesting looking veins on the Moffatt-Hall group, astride of the Bourlemaque-Louvicourt boundary line ; encouraging underground results at the Sullivan

and Greene-Stabell properties, near Lake DeMontigny and east of the Siscoe mine ; promising gold discoveries on the Francœur group and at the Arntfield mine in Beauchatel township ; encouraging results from development work on the Galatoa property in Duparquet township ; and diamond drilling on the Gale claims and on the East Sullivan group in Dubuisson township. A new gold discovery which appears to be promising has been made recently on the McWatters claims, six miles south-east of Noranda.

SHORT NOTICES

Mining Systems.—A paper presented by R. K. Warner at the February meeting of the American Institute of Mining and Metallurgical Engineers deals with the selection of a mining system (Contribution No. 21).

Tunnelling.—Work on the Owyhee tunnels in eastern Oregon is described by P. R. Hines in a paper read before the February meeting of the American Institute of Mining and Metallurgical Engineers (Contribution No. 1).

Rockbursts Prevention.—In the *Journal* of the South African Institution of Engineers for February G. Hildick Smith gives a description of the work of taking out an inadequate pillar at the West Vertical Shaft, Nourse Mines.

Surveying.—A description of the Tavistock theodolite by W. H. Carnell appears in the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for December last.

Rock-Drills.—In the *Engineering and Mining Journal* for February Lucien Eaton discusses rock-drills and accessories.

Power Generation.—In the *Bulletin* of the Institution of Mining and Metallurgy for February V. T. Edquist, C. Valentine, and N. Dunstan describe the use of gas power at the Sons of Gwalia mine, Western Australia.

Ore-Shoots.—Harrison Schmitt discusses the determination of ore-shoot bottoms in *Engineering and Mining Journal* for February.

Subsidence.—Technical Publication No. 502 of the American Institute of Mining and Metallurgical Engineers by H. C. Howarth describes subsidence from pillar extraction at Montour No. 10 mine, adjacent to the experimental mine of the United States Bureau of Mines.

Athens System of Mining.—Subsidence resulting from the Athens system of mining at Negaunee, Michigan, is described by C. W. Allen in a paper presented at the February meeting of the American Institute of Mining and Metallurgical Engineers (Contribution No. 3).

Ventilation.—W. E. Cooke and I. C. F. Statham discuss a practical problem in ventilation in *Colliery Engineering* for February.

Ore-Dressing.—The relationship between ore-dressing and coal preparation is discussed by E. A. Holbrook in Contribution No. 16 presented at the February meeting of the American Institute of Mining and Metallurgical Engineers.

Grinding.—The "grindability" of various ores is discussed by W. L. Maxon, F. Cadena, and F. C. Bond in a paper presented at the February meeting of the American Institute of Mining and Metallurgical Engineers (Contribution No. 25).

Cyanidation.—E. S. Leaver, J. A. Woolf, and T. A. Jackson in a paper presented at the February meeting of the American Institute discuss the cyanidation of calcined gold ores made refractory by the presence of lead minerals (Contribution No. 5).

Flotation.—The second part of a study of the principles of flotation by I. W. Wark and A. B. Cox appears in Technical Publication No. 495 of the American Institute of Mining and Metallurgical Engineers.

Xanthates and Galena.—The action of alkali xanthates on galena is discussed by T. C. Taylor and A. F. Knoll in Contribution No. 26 to the February meeting of the American Institute of Mining and Metallurgical Engineers.

Butte Copper.—B. S. Morrow and G. G. Griswold give the result of laboratory investigations into the production of a high-grade concentrate from Butte copper ores in a paper presented at the February meeting of the American Institute (Contribution No. 27).

Silver-Lead Smelting.—In *Mining and Metallurgy* for February H. R. MacMichael discusses silver-lead smelting progress in Chihuahua, Mexico.

Roasting Zinc Blende.—Professor Brenthel, of Freiberg, discusses the roasting of zinc blende in *Metall und Erz* for February 2.

Pig-Iron.—E. C. Evans in the *Iron and Coal Trades Review* for February 24 gives some considerations affecting the influence of furnace size on fuel consumption in pig-iron production.

Screw Conveyors.—In *Mines, Carrières, Grandes Entreprises* for February C. L. Puech goes into the theory of screw conveyors.

Native Silver.—The results of an experimental investigation into the mode of origin of the wire-form of native silver are given by C. B. E. Douglas in the *Bulletin* of the Institution of Mining and Metallurgy for February.

Electrical Prospecting.—A new contribution to sub-surface studies by means of electrical measurements in drill-holes by C. and M. Schlumberger and E. G. Leonardon is given in Technical Publication No. 503 of the American Institute of Mining and Metallurgical Engineers.

Diamond-Drill Sampling.—W. Rex Storms discusses diamond-drill sampling practice in the *Engineering and Mining Journal* for February.

Ore in the Rockies.—Technical Publication No. 501 of the American Institute of Mining and Metallurgical Engineers by P. Billingsley and A. Locke discusses the tectonic position of ore districts in the Rocky Mountain region.

Cracow Field, Queensland.—Operations on the Cracow Goldfield, Queensland, are described by A. K. Denmead in the *Queensland Government Mining Journal* for December 15 last.

Cœur d'Alene.—O. H. Hershey discusses the mining geology of the Cœur d'Alene district, Idaho, in *Mining and Metallurgy* for February.

Tin in Nigeria.—W. E. Sinclair describes Nigerian placer mining in the *Engineering and Mining Journal* for February.

Washington Mine, New Jersey.—A paper presented by C. H. Loux at the February meeting of the American Institute of Mining and Metallurgy (Contribution No. 32) discusses mining methods and costs at the Washington mine, New Jersey.

Gold Placers in Chile.—The mining of gold placers in Chile is described by Dr. Bruno Geier in *Metall und Erz* for February 1.

Fluorspar in America.—E. F. Burchard describes the fluorspar deposits of the Western

United States in Technical Publication No. 500 of the American Institute of Mining and Metallurgical Engineers.

Natural Gas.—Technical Paper 539 of the United States Bureau of Mines by T. W. Johnson and W. B. Berwald discusses the deviation of natural gas from Boyle's law.

Water on the Rand.—E. J. Laschinger discusses the Witwatersrand mine water supply and consumption in the *Journal* of the South African Institution of Engineers for February.

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.*

10,528 of 1931 (386,330). G. Polysius A.-G., Dessau, Germany. Cement, lime, or other materials are dried by exhaust gas from the rotary furnace before being calcined on a travelling grid.

11,402 of 1931 (385,315). J. Blumenfeld, Paris. In order to prepare a fine and homogeneous product precipitated titanium oxide is calcined and reground in the wet state in the presence of weak alkali, the finer particles being preserved in suspension for further treatment and dilution.

13,436 of 1931 (386,310). A. A. Johnson, B. M. S. Kalling, and C. von Delwig, Avesta, Sweden. Finely-divided ores mixed with carbonaceous materials are reduced in a rotary furnace by coke-oven gas or other gases, the original carbonaceous material passing through the furnace unaltered. The reaction is carried on at such a temperature that fusion is avoided.

23,748 of 1931 (385,352). I. G. Farbenindustrie A.-G., Frankfort-on-Main, Germany. Impure sulphur solutions in carbon disulphide, obtained during the purification of illuminating gas or coke oven gas, yield pure sulphur after treatment with sulphuric acid containing substantial amounts of nitric acid.

27,310 of 1931 (385,374). H. D. Tollemache, London. Grinding or pulverizing apparatus in which the ground particles are removed from the grinding zone by air currents.

33,177 of 1931 (385,413). Soc. Anon, Sud Metaux, Marseilles. Bronze waste or scrap is packed between two diaphragms and electrolyzed, the copper being recovered at the cathode and the tin, lead, and precious metals from the mud formed in the cells.

8,549 of 1932 (385,803). M. P. Brodsky, Ural, U.S.S.R. Special oscillatory screens for the treatment of low-grade asbestos rock.

20,123 of 1932 (385,551). H. Th. Böhme, A.-G., Chemnitz, Germany. Improvements in the manufacture of carbonyl compounds.

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.

Elements of Mining. 3rd edition. By George J. Young. Cloth, octavo, 707 pages, illustrated. Price 36s. London: McGraw-Hill Publishing Co.

Mine Examination and Valuation; with Interest and Annuity Tables. By Charles H. Baxter and Roland D. Parks. Appendix by Franklin G. Pardee. Cloth, octavo, 316 pages, illustrated. Price $3·00. Houghton, Michigan: Michigan College of Mining and Technology.

Handbuch der Geophysik. Vol. IV, part 4. Die zeitliche Folge der Erdbeben und bebenauslösende Ursachen. By Prof. V. Conrad. Paper covers, pp. 1,007–1,190. Price RM. 39, subscription price RM. 26. Berlin: Gebrüder Borntraeger.

Concrete Engineering. Vol. 1—Practical Concrete. By J. Singleton-Green. Cloth, octavo, 258 pages, illustrated. Price 8s. London: Charles Griffin and Co.

Metallic Alloys: Their Structure and Constitution. 5th edition. By G. H. Gulliver. Cloth, octavo, 439 pages, illustrated. Price 12s. 6d. London: Charles Griffin and Co.

Practical Microscopical Metallography. 2nd edition, revised and enlarged. By Richard Henry Greaves and Harold Wrightson. Cloth, octavo, 256 pages, illustrated. Price 18s. London: Chapman and Hall.

A Descriptive Petrography of the Igneous Rocks. Vol. 2: The Quartz-Bearing Rocks. Cloth, large octavo, 421 pages, illustrated. Price $5·50. United States of America: University of Chicago Press.

Lubricating and Allied Oils. 2nd edition, revised and enlarged. By Elliott A. Evans. Cloth, octavo, 175 pages, illustrated. Price 9s. 6d. London: Chapman and Hall.

Measurements of the Kinetic Loads on Colliery Winding Ropes. Safety in Mines Research Board Paper No. 78. By S. M. Dixon and M. A. Hogan. Paper covers, 28 pages, illustrated. Price 1s. London: H.M. Stationery Office.

The Geology of the South Wales Coalfield. Part V—Merthyr Tydfil (2nd edition). Memoir of the Geological Survey of England and Wales. Paper boards, 283 pages, illustrated. Price 5s. 6d. London: H.M. Stationery Office.

Miners' Welfare Fund. Eleventh Report, 1932. Paper covers, quarto size, illustrated. Price 1s. 6d. London: H.M. Stationery Office.

Canada: Department of Mines. Investigations in Ore Dressing and Metallurgy, 1931. Paper covers, 183 pages, illustrated.

British Columbia: Preliminary Report on the Mineral Industry, 1932. Paper covers, 52 pages typescript. Victoria, B.C.: Bureau of Mines.

Nyasaland Protectorate: The Portland Cement Clays of Lake Malombe. By Dr. F. Dixey. Nyasaland Protectorate Geological Survey Bulletin No. 4. Paper covers, folio size. Zomba: Government Printer.

Mineral Resources of the United States, 1931. Part I, pp. 117–151, Iron Ore, Pig Iron, and Steel, by H. W. Davis; pp. 153–184, Manganese and Manganiferous Ores, by R. H. Ridgway; pp. 185–190, Vanadium, Uranium, and Radium, by F. L. Hess; pp. 191–209, Mercury, by P. M. Tyler and H. M. Meyer; pp. 211–225, Lead and Zinc Pigments and Salts, by E. W. Pehrson. Part II, pp. 71–87, Cobalt, Molybdenum, Tantalum, and Titanium, by P. M. Tyler and A. V. Petar; pp. 179–190, Feldspar, by H. H. Hughes and J. Middleton; pp. 191–203, Gypsum, by R. M. Santmyers and J. Middleton; pp. 205–213, Asbestos, by O. Bowles and B. H. Stoddard. Each part in paper covers. Washington: Superintendent of Documents.

Rand Goldfield. New map compiled and drawn by ALFRED J. CLEVELEY. Size 34 in. by 20½ in. Price 5s., or, mounted on linen, 10s. 6d., or, on rollers and varnished, 15s. London: The *Financial Times.*

South African Mining and Engineering Year Book. Paper boards, cxxxii + 376 pages, illustrated. Price 10s. 6d. London: Argus South African Newspaper.

Rhodesian Mining and Engineering Year Book. Paper boards, cxxvii + 144 pages, illustrated. Price 10s. 6d. London: Argus South African Newspapers.

Kaffir Facts and Figures. Working Costs, Recent Profits, Outputs, Monthly Crushings, etc. Paper covers, pocket size, 48 pages. Price 1s. London: Fredc. C. Mathieson and Sons.

Monthly Mining Handbook, with Price Lists, etc. Mid-February, 1933. Paper covers, pocket size, 62 pages. Price 1s. 6d. London: Fredc. C. Mathieson and Sons.

COMPANY REPORTS

Geldenhuis Deep.—This company was formed in 1893 and works a gold-mining property on the Central Rand. The report for the year 1932 shows that 969,751 tons of ore was mined and, after sorting out waste, 886,900 tons sent to the mill, which crushed 885,900 tons. The gold yield amounted to 203,840 oz., valued at £864,462, while the value of osmiridium and silver recovered increased the total revenue to £866,345. Working costs amounted to £791,223 and the working profit to £75,122, dividends amounting to 10% and absorbing £56,667 being distributed during the year. The available ore reserves at the end of the year were estimated to be 413,700 tons, averaging 5·5 dwt. in value, as compared with 448,200 tons of the same grade at the end of the previous year. Work during the year under review was hampered by two severe pressure bursts and it is expected that some months will elapse before normal operations are resumed.

Village Deep.—This company, formed in 1898, disposed of its mining rights on the Central Rand, together with certain equipment, to the Robinson Deep, Ltd., in February, 1930. During the year 1932 the nominal value of the shares was reduced from 9s. 6d. to 8s. 6d. each by returning paid-up capital to the extent of 1s. per share, the company's capital now standing at £425,048 0s. 6d. in 8s. 6d. shares. The subsidiary clean-up proceeded throughout the year on a small scale, the net amount recovered being £7,109, and it is expected that these operations will shortly terminate. The cash assets at the end of the year were estimated to be £42,568.

Batu Caves Tin Dredging.—This company was formed in 1927 and works alluvial tin property near Kuala Lumpur, F.M.S. The report for the year to August 31 last shows that dredging operations were very restricted, the dredge having worked only on 112 days. The yardage treated amounted to 434,600 cu. yd., the ore recovered totalling 129·54 tons, valued at £10,430, an average of £80 10s. 4d. per ton of ore. The accounts show a credit balance of $546·42, which was carried forward. Deeper check boring has now been completed over the company's property and ore reserves are now estimated at 15,396,500 cu. yd. of ground carrying 96,356 piculs of ore, as against 8,861,530 cu. yd., containing 52,525 piculs, previously estimated.

Rantau Tin Dredging.—This company was formed in 1925 and operates alluvial tin property in the State of Negri Sembilan, F.M.S. The report for the year ended July 31 last shows that under restricted conditions the two dredges treated 1,085,600 cu. yd. of ground and recovered 237·11 tons of tin ore, valued at £59 2s. 11d. per ton. The accounts show a working profit of $13,321·67, but, after making allowances for depreciation, etc., there was a loss of $570·81, increasing the debit balance brought in to $15,251·63.

Batu Selangor Tin Dredging.—Formed in 1930, this company works alluvial tin property at Batu, Selangor, F.M.S. The report for the year to August 31, 1932, shows that under restricted conditions the dredge treated 711,600 cu. yd. of material, recovering 252·8 tons of tin ore, worth £20,267 or £80 3s. 5d. per ton. The accounts show a working profit of $69,578·46, of which $34,125 was distributed as a dividend, equal to 2½%. After making other allowances there remained a credit balance of $1,662·95, which was carried forward.

DIVIDENDS DECLARED

Amalgamated Zinc.—2½%, less tax, payable April 7.

Burma Corporation.—1½ annas, free of tax, payable April 13.

Cam and Motor.—7s. 6d. (return of capital).

Champion Reef.—2s., less tax, payable March 18.

Chosen Corporation.—5¼d., less tax, payable March 31.

Lake View and Star.—6d., less tax, payable April 6.

Malayan Tin.—1½d., less tax, payable March 17.

Mysore.—1s., less tax, payable April 1.

Nundydroog.—4s., less tax, payable April 4.

St. John del Rey.—Pref., 1s., free of tax; Ord. 1s. 3d., less tax, payable April 28.

Witbank Colliery.—6d., less tax, payable April 10.

NEW COMPANIES REGISTERED

Anglo Australian Gold Development.—Capital: £400,000 in 5s. shares. Objects: To finance, promote, and manage mining properties in Western Australia. Directors: Sir William R. Campion, John Waddington, Claude de Bernales, Harry M. Ridge, and Louis C. Cutbill. Offices: 5, Great Winchester Street, E.C.2.

Pakaneusi Prospecting and Development.—Registered in Kenya. Capital: 2,000,000 shillings, divided into 70,000 "A" shares of 5s. each and 330,000 "B" shares of 5s. each. In December last 86,000 of the "B" shares were offered in Kenya for public subscription at par. Objects: To acquire 163 precious metal reef claims in the Kakamega district of Kenya Colony and an exclusive prospecting licence over a distance of 60 or 70 miles along the rivers Lusumu, Sioko, and Lugusidz in the Nyanza Province. Directors: Lt.-Col. Lord Francis Scott, Sir James Allan Horne, Philip John Hamilton Coldham, Percy Wheelock, and Edward Cayley Harrison.