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CONTENTS

EDITORIAL

IN this issue is the first of a series of articles by Dr. S. W. Smith on some metallurgical aspects of the Empire Mining and Metallurgical Congress, held in South Africa earlier in the year. Its appearance affords an opportunity of paying further tribute to the efforts made by the hosts to interest as well as entertain their visitors from overseas, as evidenced by the wealth of detailed information disclosed in the papers presented at the various sessions.

THE Prince of Wales was the principal guest at a dinner at the Guildhall on November 13, under the chairmanship of Sir Ernest Rutherford, the president of the Royal Society. The occasion was the launching of an appeal for support for the objects for which the Association of Scientific and Technical Institutions—to give it its shorter title—has been formed, chief among which is the erection of a central building in Westminster for housing a number of associated technical and industrial bodies.

IN continuation of a reference made here last month to prospective railway developments in Uganda, it is now announced that the recent deliberations in Brussels resulted in substantial agreement between the British and the Belgian officials. A line is proposed to extend the existing Kenya-Uganda railway from Mombasa to Kasindi, on the Belgian Congo border, via Kampala. The Belgians may connect Kasindi with Stanleyville, but their chief desire is to construct a line from Stanleyville to the Kilo Moto gold mines, situated north of Irumu.

WE commented here in September on Sir Thomas Holland's observations on the need for an adequate iron and steel industry in South Africa and in the light of those remarks interest attaches to the new works which are shortly to be erected in Pretoria, for the construction of which tenders, mostly from British firms, have just been accepted. Pretoria has been selected for the site because it stands close to supplies of both coal and iron ore, the deposits at hand of the latter being estimated to contain 45 million tons of 48 per cent. ore, while 100 million tons of pure hematite ore, containing 68 per cent. iron, are but 100 miles distant.

THE Metalliferous Mines Advisory Committee at the instance of the Secretary for Mines has appointed two sub-committees to inquire into the possibilities of developing, or reviving, the working of metalliferous and associated deposits in Great Britain. The committee for non-ferrous mining is constituted as follows:—Messrs. J. J. Burton (chairman), W. H. Bennett, Clive Cookson, Frank Merricks, R. A. Thomas, and Anthony Wilson. A similar committee under the same chairmanship, but of which Professor Henry Louis is also a member, will consider iron-ore mining. It will be recalled that Professor Louis recently held an inquiry into the possibilities for gold mining in North Wales, the result of which has yet to be heard.

Ore-Reserves and Drilling Records

The first meeting of the 1930–31 session of the Institution of Mining and Metallurgy, on October 16, was devoted to the discussion of two papers originally presented to the Third (Triennial) Empire Mining and Metallurgical Congress, held in South Africa earlier this year. The first was that by Professor Truscott on "The Computation of the Probable Value of Ore-Reserves from Assay Results," full extracts from which were given in the MAGAZINE for May last, and the second, by Mr. J. Allen Howe, assistant director of the Geological Survey of Great Britain, dealt with the "Conservation of Drilling Records." Both of these papers furnished material for interesting discussion.

The usual practice in the evaluation of ore-reserves is, as Professor Truscott noted, to weight each assay by the width, the resulting products, in inch-dwt. or feet-per cent., being then considered as on such a comparable basis that their arithmetic mean represents the average for the series. Further, the underlying assumption of this method is that the other dimensions which make up the ore-block—that is, length along the exposure and depth behind the sampled face—are accurately represented by the sample taken. The author of the present paper disputes this assumption, arguing that

since high assay values are rare in a sampling series such values cannot be taken to spread over so great a length of exposure nor so large a block of ore. He points out that, although the infrequency of the high assay weights it for the exposure length, it is not weighted sufficiently for volume. The result of this method, involving the arithmetic mean of an inch-dwt. series, is to give too high a value to ore-reserves. To an extent this has been met by the arbitrary practice of cutting high assays, but still the method retains its fundamental inaccuracy. This has been previously noted, by Denny in 1917 and Watermeyer in 1919, the latter being the first to recognize that frequency should enter the computations a second time. In the present paper the author points out that to allow frequency alone to enter the computation a second time is to treat the unexposed face in a different way from the exposed face and he submits that the square of the product of frequency and inch-dwt. would give figures on a comparable basis permitting the most probable value of ore-reserves to be calculated. It will be recalled that Professor Truscott's paper gives as an example a series of assays taken in the Shamva mine, Rhodesia, the final value of the ore-reserves made on the new method closely agreeing with the proved value of the ore determined by actual mining of the ore blocked out. In the discussion on the paper when it was first read in South Africa, Professor Watermeyer considered that weighting by frequency alone was sufficient, although it was pointed out by the author that this would actually make the ore-body poorer for the occurrence of high values. At the October meeting Mr. T. Pryor showed by means of examples that the method was inapplicable to certain types of gold veins, although the author claimed that too few samples had been taken for its application on those particular levels. Mr. Pryor also considered irrelevant the fact that the method was bound to give a low result, as the engineer should endeavour to get as close to the truth as possible. Messrs. B. W. Holman, C. Palmer, and W. G. G. Cooper contributed to the discussion of a matter that touches the roots of accurate ore-reserve estimation.

In the paper of Mr. Allen Howe the attention of congress members was directed to the desirability of formulating a scheme for the conservation of drilling records for submission to the requisite administrative departments, in the hope that it might be given legal status and put into early operation. The author pointed out that as the result of an accident in 1924 the lack of information regarding old mines in this country was forcibly demonstrated and an appeal for the deposition of old mining plans had good results, but it was recognized that records which would have enabled old plans to be checked had in many instances not been preserved. It was thus the more imperative that all recent records and certainly the results of all future work should be accessible to those desirous of consulting them. During the discussion on this paper, which was generally favourable to the scheme, it was evident that the prevailing view was that nothing could really be done to render it effective short of making it compulsory by legislation.

Royal Geographical Society's Centenary

The closing days of last month witnessed the celebration of the centenary of the Royal Geographical Society. On October 21 the Duke of York presided at an afternoon session, when delegates from the Société de Géographie, of Paris, and the Gesellschaft für Erdkunde, of Berlin, both of which have already celebrated their centenaries, presented addresses. A series of short papers by British and foreign geographers on "The Habitable Globe" was presented on the mornings of October 22 and 23, followed by another on the afternoon of October 23 on "Incidents in the History of Exploration." The proceedings came to an end on the evening of October 23, when the Prince of Wales presided at the centenary dinner.

The debt of the mining industry to the explorers who blazed the paths into the unknown and little known portions of the globe cannot be too strongly emphasized. It must not be forgotten also that the search for mineral wealth has often been the incentive to exploration. In the early days of last century the need for a parent organization which would aid in the extension of geographical knowledge was badly felt in this country. In 1821 France instituted the Société de Géographie in Paris and in 1828 Berlin founded the Gesellschaft für Erdkunde, but it was not until 1830 that the foundation of our geographical Society was brought about. At a public meeting held on July 16, 1830, under the chairmanship of John

Barrow, Secretary to the Admiralty, Viscount Goderich was elected the first president of the Society, to which King William IV, who became its patron, gave the title "Royal Geographical Society." His Majesty also granted an annual donation of fifty guineas to constitute a premium for the encouragement of geographical science and discovery, the first recipient being Richard Lander for his discovery of the termination of the Niger in the sea.

The early meetings of the society were held in the apartments of the Horticultural Society and elsewhere and it was not until 1913 that it secured a settled habitation at its present house in Kensington Gore. Here an additional building has recently been completed and the present accommodation includes a meeting hall with seating for 850 persons, ample library space, and other amenities which permit the society to carry on its important work. The help which has been given by this body to exploration in Africa, Asia, and the Arctic and Antarctic, and also to such undertakings as the Mount Everest expeditions is well known. The scope of its operations and the enlightened manner in which it is envisaged is exemplified by the assistance it has given to the British Arctic Air Route Expedition by supplying the best instruments it could furnish, in addition to a sum of money. Members of the mining profession will join with all explorers in wishing the society continued prosperity and long-lived activity.

Rand Low-Grade Ore Commission

The term ore has been defined as a mineral occurring in the earth's crust from which a metal or metals can be profitably extracted. The influence of mining costs, therefore, on what part or parts of a mineral deposit may be truly classed as ore is readily appreciated. One other factor also plays its part in the determination of real ore-reserves and that is the price obtainable for the finished product, so that what may be regarded as constituting ore-reserves in base-metal mines will be governed by the prevailing prices of those metals. In the case of gold, however, the price is fixed and mining costs alone determine which part of a deposit may be justly included in the ore-reserves. The gold deposits of the Rand include vast tonnages of low-grade material at present unworkable, but which with very little decrease in present working costs would fall into the payable category. In the September issue of the MAGAZINE, in the course of a review of the Union Government Mining Engineer's estimate of the life of the Rand, it was noted that a reduction in working costs of only two shillings per ton would mean on that field that there would be no appreciable diminution of output during the next eight or ten years. The present position on the Rand is becoming more clearly defined by the evidence which is being brought before the Low-Grade Ore Commission now sitting in South Africa, reference to which is made by our Johannesburg correspondent in this issue. Apart from proposals for the adjustment of the phthisis burden, for the reduction of railway freight charges, and for relief from the perpetual anxiety concerning the supply of native labour, two main lines of thought have been revealed in such reports of the evidence presented to the commission as have been so far available. The first of these lies in the proposals of Dr. Hans Pirow, the Government Mining Engineer, for a reorganization of the industry and the second in the views of the Gold Producers' Committee, put forward by Dr. P. M. Anderson.

Examining in the first place the second of these views, it may be said at once that the committee consider a reduction in European salaries and wages throughout South Africa eminently desirable and a general cut of 5 per cent. has been suggested. Dr. Anderson, in presenting the views of the gold producers, said that the total working costs for the Rand mines during 1929 amounted to £29,819,536, or 19s. 7d. per ton of ore milled. Wages to Europeans absorbed 24·8 per cent. of this amount, wages to natives 20·4 per cent., and expenditure on stores 43·4 per cent. Of the stores used it was estimated that 67 per cent. was of South African origin and in this connexion the high level of wages in the Union must be considered an important factor. The committee held the view that workers in South Africa were better off than in any other country and that a reduction in wages was desirable, the maintenance of the present standard hitting the primary producer very hard. This attitude of the Gold Producers' Committee has at least the merit that it examines the economic position of South African industry as a whole, it being felt that adjustment between conditions in South Africa and the rest of the world are economically necessary.

The Government Mining Engineer, in his evidence before the commission, gave details of his proposal for the reorganization of the labour on the Rand mines. He recommends that, as far as possible, native labour, less susceptible to phthisis, should be substituted for white labour underground, surface employment being found for the displaced whites. In addition, Dr. Pirow would increase mechanization in the handling of material, including increased sorting, and would introduce finer grinding, flotation processes, dump re-treatment, and the utilization of waste products. It was also suggested that the mines should aid in the manufacture within the Union of much of the material which is at present imported.

New Ontario Government Building

In the presence of the Prime Minister and the Secretary of State for the Dominions, the Hon. G. Howard Ferguson, the Premier of Ontario, declared open the new offices of the Agent-General for Ontario in the Strand on October 21. Mr. William C. Noxon, who has been Agent-General since 1921, presided over the proceedings, which were attended by a number of distinguished Anglo-Canadians and British industrialists and engineers. In the course of a number of speeches appropriate reference was made to the progress of the province and the important position it now occupies in the Dominion, hence the need for more commodious premises in which to carry on its work in London.

The building, the façade of which is shown in the accompanying photograph, may be said to be in every way worthy of its object, constructed as it is almost in its entirety of materials imported from Ontario and fabricated by British workers. Thus the granite employed for the two corner-stones comes from Coe Hill, the building stone for the front is Queenston blue dolomite, marble extensively used for interior decoration is from Bancroft, the birch and pine for woodwork construction is from the forests in the north of the province, and extensive use is made of nickel fittings, the origin of which needs no explanation. The furniture and general interior decoration scheme can only be described as sumptuous and altogether an effect of wealthy but unostentatious comfort has been imparted.

The province of Ontario is of principal interest to the mining community as the producer of 90 per cent. of the world's nickel and as containing the gold mines of the extensive and rich Porcupine and Kirkland Lake areas. The value of the

nickel and cobalt deposits of the Sudbury area has, moreover, been recently enhanced by the discovery of an enormous ore-body rich in copper. Altogether the mineral production of the province for 1929 amounted to over $117,000,000 and the preliminary figures for the first half of 1930 represent a gain of $3,000,000 over the corresponding period of 1929. Of that total the metallic minerals account for some $84,000,000 and they include, beside the nickel and gold mentioned, copper, lead, zinc, silver, cobalt, platinum, and palladium, altogether a field as diverse as it is rich.

REVIEW OF MINING

Introduction.—Conditions in the base-metal markets continue depressed, although the feeling is gaining ground that prices are at bottom, or nearly so, in spite of the fact that production is still somewhat ahead of consumption. The meetings of copper producers in America and the report that a tentative agreement on outputs has been reached have reacted favourably on the price of the metal, whilst with tin the news that the deliveries in the United States during October exceeded the supplies indicated that metal stocks were being replenished.

Transvaal.—The output of gold on the Rand for October was 884,632 oz. and in outside districts 41,929 oz., making a total of 926,561 oz., as compared with 903,176 oz. in September. The natives employed on the gold mines at the end of the month totalled 206,778, as compared with 205,061 at the end of September. The output for October sets up a record and reflects the improved labour position, the natives employed on the mines being 17,000 more than a year ago.

A circular to shareholders in Daggafontein Mines, Ltd., states that in the newly acquired area adjoining Springs Mines some 21,000 ft. of development, of which less than 14,000 ft. was on reef, has disclosed 806,095 tons of ore averaging 8·55 dwt. over 45 in., whilst in the section around Nos. 1 and 2 shafts 14,595 ft. of development, 6,296 ft. being on reef, has disclosed 227,728 tons of ore averaging 8·98 dwt. over 37 in., making a total of 1,033,823 tons, averaging 8·64 dwt. over 43 in. stoping width. It is considered that the present position warrants the erection of a reduction plant of substantial capacity and its design is in hand.

At the annual meeting of the Sabie (Transvaal) Gold Mining Company, to be held on December 11, an extraordinary resolution will be proposed for the voluntary winding up of the company.

Diamonds.—Towards the middle of October it was announced by Mr. A. P. J. Fourie, Minister of Mines for the Union of South Africa, that arrangements had been made between the Union Government and the Diamond Syndicate for the renewal of the sales agreement.

At an extraordinary meeting of De Beers Consolidated Mines, to be held in Kimberley on December 15, immediately following the annual meeting, it will be proposed that the capital of the company be increased from £4,750,000 to £5,500,000 by the creation of 300,000 deferred shares of £2 10s. each. It is understood that none of the new shares are to be issued for cash or to the existing shareholders.

Premier (Transvaal) Diamond Mining Company has postponed the payment of the usual half-yearly dividend on its preference shares.

Southern Rhodesia.—The output of gold from Southern Rhodesia during September was 46,151 oz., as compared with 46,152 oz. for the previous month and 45,025 oz. for September, 1929. Other outputs for September were: Silver, 5,720 oz.; copper, 125 tons; coal, 90,690 tons; chrome ore, 9,292 tons; asbestos, 3,974 tons; mica, 10 tons; tin, 2 tons.

During the year ended May 31 last the profit of the Gold Fields Rhodesian Development Company was £116,659, which, with £50,847 brought forward, made an available total of £167,506. An interim dividend of 5% absorbed £62,855 and after making various allowances the balance of £71,784 was carried forward. No property has so far been found to replace the Shamva mine, which closed at the end of May. Developments at the Wanderer mine, referred to elsewhere in this issue, may make it advisable to extend the reduction plant. At the Mayfair the breakdown of plant has necessitated suspension of milling operations, but development work has been continued.

Northern Rhodesia.—Towards the middle of last month it was announced that the American Metal Company had acquired from the Canadian Selection Company 800,000 English ordinary shares of the Roan Antelope Copper Mines and 1,000,000 ordinary shares of the Rhodesian Selection Trust in exchange for 350,000 shares of the common stock of the American Metal Company and $1,000,000 in cash. It was explained that the 350,000 American Metal Company shares would not rank for dividends before December 1, 1932.

Shareholders of Rhodesian Congo Border Concession have been advised of the final results from three bore-holes. The first, N.E. 43, entered the River lode horizon at 255 ft. and from 260 ft. to 310 ft. the ground averaged 8·08% copper, mainly in the oxidized condition. In the second hole, N.E. 41, the ground from 430 ft. to 485 ft. averaged 5·79% copper, from 485 ft. to 515 ft. there was no commercial ore, and the 12·8 ft. from 515 ft. to 527·8 ft. averaged

2·98% copper. In the last hole, N.E. 51, also on the River lode horizon, the 60 ft. from 400 ft. to 460 ft. averaged 7·12% copper.

The chairman of the Rhodesian Congo Border Concession and N'Changa Copper Mines found it necessary towards the end of October to issue a denial of certain rumours which had suggested that negotiations were in hand for the absorption of the N'Changa and Bwana M'Kubwa companies by the Rhodesian Congo Border Concession.

South-West Africa.—The acquisition of prospecting rights in South-West Africa by the Consolidated Mining and Smelting Company of Canada was noted in the September issue of the MAGAZINE. It has recently been announced that the concession covers an area of 48,000 square kilometres bordering on the concession held by the South-West Africa Company and the Otavi Minen Gesellschaft. The area contains several tin mines, the rights of which will not be affected.

Nigeria.—The report of the Naraguta (Nigeria) Tin Mines, Ltd., for the year ended March 31 last shows a working profit of £6,103, which, added to the sum of £28,325 brought forward, gave an available total of £34,428. After writing off the balance of abonnement renewal account of £891, the balance of £33,537 was carried forward. During the period under review 389 tons of tin concentrates was recovered, as compared with 351 tons in the previous year, the average price realized being £117, against £139. To meet conditions created by the existing depression, a system of skeleton staffs has been put into force on all areas of the Naraguta group, which should enable it to carry on without a complete closing down.

Australia.—At the annual meeting of the Electrolytic Zinc Company of Australasia, recently held in Australia, it was announced that the abnormal circumstances now existing and the extent to which money was temporarily locked up in unsold zinc would probably preclude the payment of the half-yearly dividend usually declared in January.

A circular to shareholders of the Associated Northern Blocks (W.A.) states that a meeting is to be held next month when resolutions for the voluntary liquidation of the company will be considered. The present liquid assets are estimated to be approximately 1s. 9d. per share, there being in addition the company's properties and plant in Western Australia and Mexico. At an extraordinary meeting to be held subsequently resolutions will be considered changing the name of the company to the Associated Northern Blocks Mining and Investment Company and reducing the par value of the shares and creating additional capital.

Malaya.—A circular to shareholders of the Perak River Hydro-Electric Power Company states that the construction of the dam and power-house at Chenderoh has been completed, the steam station at Malim Nawar being closed down except for the standby plant. The depression in the tin mining industry has seriously delayed the growth of the company's business, revenue still being mainly dependent upon sales of power to the mining properties in the Kinta Valley. There are signs, however, that the industry is awakening to the advantages of electric power and preparing for the return of better times. The way in which the company is demonstrating the intelligent application of electricity to mining forms the subject of comment elsewhere in this issue.

Venezuela.—A circular to shareholders of the South American Copper Company, Ltd., states that early runs of the new flotation plant were disappointing, making it advisable to increase the number of cells in the plant. Operations were recommenced early in September last, but results continued to be unsatisfactory with run-of-mine ore, which averages 3·5% copper. Early in October, however, the existence of an extensive body of high-grade ore along the western side of the Aroa mine was definitely proved. This body lies west of the fault zone, which hitherto has been erroneously regarded as the limit of mineralization. Developments on the 50 fathom level have for some time past been in this ore-body, which is said to improve in dimensions and value going westward. From a foot-wall drive on the 16 fathom level the new ore-body has been cross-cut and driven on for 40 feet, in ore assaying between 6 and 7% copper.

Bolivia.—At an extraordinary general meeting of the Corocoro United Copper Mines, Ltd., last month the reduction of the capital of the company from £750,000 to £451,988 16s. by the cancellation of paid-up capital which has been lost or which is unrepresented by available assets to the extent of 8s. on each issued ordinary share was approved.

Panama.—Shareholders of Panama Corporation, Ltd., have been advised of favourable developments in the extreme north of the Remance mine. On the 5th level

the north drive has encountered high-grade ore at 617 ft. north of the main shaft. Driving has been continued for 636 ft. and the face was said to be still in ore. Sampling along 19 ft. gave values running to £22 per ton over 34 in. On the 4th level, at a distance of 1,870 ft. from the mouth of the tunnel, a winze sunk on the rich ore-body has reached a depth of 50 ft., samples from the bottom averaging 46s. per ton over a width of 72 in.

Yugoslavia.—A progress report of Trepca Mines, Ltd., for the quarter ended September 30 shows that stoping commenced at the Stantrg mine on August 15 last by opening out four main stopes on the 760 m. level. To the end of the quarter 16,675 tons of ore was sent to the mill, averaging 11·35% lead and 8·66% zinc, in addition to 2,800 tons from the dump, averaging 7·3% lead and 9·4% zinc. The crushing plant came into operation on August 17 and one section of the concentrator on August 20, the second section being started on August 25. By September 1 a daily treatment rate of 500 tons had been attained and by the end of September 17,371 tons of ore had been treated, yielding 2,229 tons of lead concentrates assaying 70% lead and 24 oz. silver per ton, as well as 1,003 tons of zinc concentrates assaying 47·6% zinc. Since the middle of September it has been determined that the recoveries of lead and zinc have been 95% and 85% respectively. Work on the Meljenica and Trepca prospects has been continued, a drill-hole being sunk north of the former to test favourable indications obtained by the Elbof Geophysical Company.

Chemical and Metallurgical Corporation.—A circular to shareholders of the Chemical and Metallurgical Corporation, sent out at the end of last month, contains the preliminary report of the shareholders' committee. This states that the corporation has sufficient funds at its command to carry on business according to present plans and that the reorganization of the works has resulted in substantial economies in production costs. During July the plant was working at slightly under 50% capacity and the accounts for the month show a small surplus.

British Aluminium Company.—At an extraordinary general meeting of the British Aluminium Company, to be held this month, it will be proposed that the capital of the company be increased from £1,500,000 to £2,400,000 by the creation of 900,000 6% preference shares. It is stated that new capital is required for carrying out the second stage of the Lochaber works scheme. At the same meeting it will also be proposed that as from January 1 next the preferential dividend shall become cumulative.

British Controlled Oilfields.—The scheme for the reorganization of the capital of British Controlled Oilfields was sanctioned by the Court of King's Bench, Montreal, last month. Application will now be made to the Secretary of State in Canada for the supplementary letters patent necessary for the carrying out of the scheme, which provides for the cancellation of $22,512,830 of capital as being unrepresented by available assets.

Tin.—The fact that at the end of October the two months' suspension of tin-winning voluntarily adopted by the companies which are members of the Tin Producers' Association has come to an end warrants a review of the tin situation. Although statistics at the end of October show a reduction in stocks it would seem that the adverse balance of demand and supply is not yet adjusted. It is thus evident that, apart from a general improvement in trade, the situation can only be relieved either when the prevailing low price causes the closing down of more properties or when more drastic restriction has been adopted by the producing companies. In this connexion the restriction scheme put forward by Mr. J. Lovett, of the F.M.S. Mines Department, is of importance. Under this scheme the author proposes the formation of a limited company, with a capital of £1,500,000, to operate in Malaya, Bolivia, Nigeria, and Siam, and to control tin output. Mines controlling 40% of the production in each country are to be asked to cease production and concentrate upon development, money for which is to be provided by the sale of 50% of their average output to the company at a price equivalent to that prevailing on the day of sale, plus 50% of the difference between such a price and £200. When the pivotal price of tin has been reached mining is to be permitted and the operating companies are to commence delivery of their product. Whether the scheme is likely to be adopted is doubtful, for the views of the Tin Producers' Association are still to be heard. Meanwhile the Billiton Company has further curtailed production and has announced its willingness to co-operate with the association in the application of any scheme of restriction.

METALLURGY IN SOUTH AFRICA

By S. W. SMITH, D.Sc., Hon.D.Sc.(Witwatersrand), A.R.S.M.
Chief Assayer, the Royal Mint.

The author gives an account of his observations of metallurgical practice when travelling with the Empire Congress.

In attempting to summarize within the compass of a short article the various aspects of metallurgical practice which were brought before the Empire Congress in the spring of this year one cannot do more than indicate briefly the general character of the information which was afforded by the papers which were read at the Sessional Meetings and that given during the actual visits to the various scenes of operation. In so doing, the primary object will be to furnish means by which fuller details of particular aspects may be readily acquired by those having a special interest in some particular phase of metallurgical activity in South Africa.

Mill and Headframe: New Modderfontein.

Until comparatively recent years the term metallurgy was restricted to the actual chemical technology by which metals were extracted from their ores and brought into a marketable condition. The fields now covered by this term, however, have widened far beyond their original limits. In this country, for example, where the actual production of metals has been a diminishing quantity for many years a large and increasing band of highly trained metallurgists has arisen whose main concern is the successful adaptation of metals and alloys to highly specialized purposes in industry. In South Africa this aspect of metallurgy is at present in its earlier stages, although evidence was forthcoming that much good work is already being done and that the foundations are being laid for the successful production of metallurgical material for engineering and other purposes.

The term metallurgist, however, in South Africa applies mainly to the man who is concerned with the actual production of metals from the products of the mines. Modern conditions demand from him far more than a knowledge and experience of the processes of metallurgical extraction. He is, in fact, a metallurgical engineer whose responsibilities cover the multitude of considerations which arise in the handling and treatment of vast quantities of materials from the moment they reach the surface. It is perhaps not untrue to say that his chief concern is to bring the material into a suitable condition for treatment by extraction processes and to do this in a manner which will render these collective operations economically possible within very narrow working limits.

These were the men whom we were privileged to meet in South Africa and more particularly, of course, on the Witwatersrand, where the magnitude to which the present operations have attained has necessitated the presence of such men. It would be impossible to give, in brief, any adequate account of the achievements of these metallurgists in their direction of general policy and in bringing the metallurgical practice

to its present high state of efficiency. It is fortunate, however, that the freedom in placing their knowledge and experience at the disposal of others, which characterizes the attitude of the mining and metallurgical professions throughout South Africa, has resulted in an abundance of published records by which this knowledge and experience has been made available to the world at large. It may be of interest, nevertheless, to indicate some of the problems which are now being solved in connexion with their work. The outstanding activities are, of course, those associated with the extraction and recovery of gold along the 70 miles' stretch of the Witwatersrand from Randfontein in the west to Springs and Sub Nigel in the east and south-east.

GOVERNMENT AREAS: A GENERAL VIEW.

During the visit of the Congress to Johannesburg opportunities were afforded by the various mining "groups" to inspect representative plants under their control. Visits were arranged to nine of these plants which, of course, constitute only one-fourth of the number at which actual operations are at present in progress. There are, altogether, 35 mines on the Rand alone sending their bullion every month to the Rand Refinery at Germiston, which also receives bullion from other parts of the Transvaal and from Rhodesia. Some idea of the magnitude of the operations which have been carried out, and which are now in progress is given by the figures which were furnished to us regarding the nine selected properties to which visits were arranged.

THE CROWN MINES.—Situated on the Central Rand (within two miles of Johannesburg and to the west) it has three reduction plants with a total crushing capacity of some 247,000 tons per month. Up to the end of 1928 the Company and its predecessors had milled some 52,800,000 tons and produced 18,600,000 ounces of fine gold.

THE ROBINSON DEEP.—Also on the Central Rand and with a crushing capacity of 80,000 tons per month. This company and its predecessors had milled to the end of 1928 some 16,500,000 tons and produced 5,800,000 ounces of fine gold.

THE VILLAGE DEEP.—The deepest on the Witwatersrand and, in fact, in the world, namely 7,638 feet in June, 1929. It has a monthly capacity of 60,000 tons, and from its inception until June, 1928, had milled 12,800,000 tons and produced 4,100,000 ounces of fine gold.

NEW MODDERFONTEIN.—Situated in the Far East, some 23 miles from Johannesburg. This property has two reduction plants with an aggregate capacity of 150,000 tons per month and to the end of 1928 the Company had milled 20,500,000 tons and produced gold to the value of £42,000,000. The South reduction plant is equipped with 64 Nissen stamps and 10 tube mills; the stamps have a weight of 2,000 lb. and a duty of 40 tons each per day.

GOVERNMENT GOLD MINING AREAS.—Also in the Far East and ranks, at present, as the largest gold producer in the world. It has a crushing capacity of some 200,000 tons per month, and to the end of 1928 had milled 22,400,000 tons and produced 9,400,000 ounces of fine gold.

LEACHING PLANT: CROWN MINES.

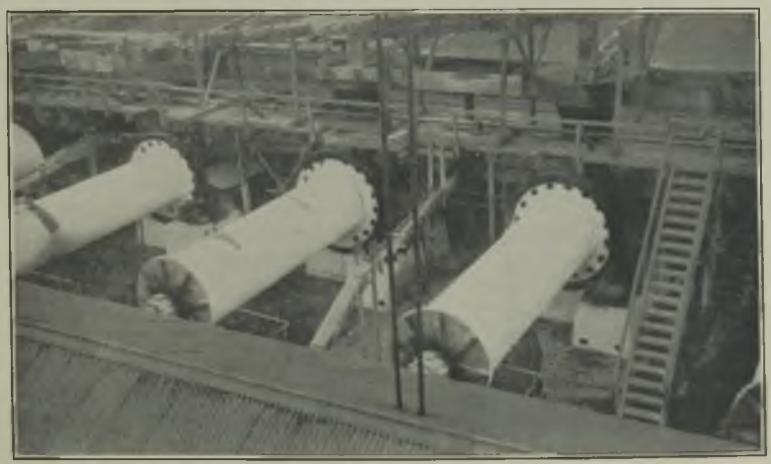
GEDULD PROPRIETARY MINES.—One of the pioneer mines of the Far East and has now reached a crushing capacity of 1,000,000 tons per annum. Up to the end of 1929 nearly 11,000,000 tons had been milled, and gold to the value of £16,600,000 had been produced.

SPRINGS MINES.—Also in the Far East. About 70,000 tons are crushed monthly and to the end of 1928, 7,200,000 tons had been milled yielding 3,300,000 ounces of fine gold. The milling section includes, besides the older stamp mill (with tube-mills producing sand and slime), the pioneer plant of the type which produces, by tube-mills only and with Dorr classifiers, an "all slime" pulp.

WEST SPRINGS.—This mine is also in the Far East. It reached the producing stage in 1924. The reduction plant is regarded as one of the most modern in type, has no stamps, operates the all-sliming process by tube mills only and crushes 68,000 tons per month. At the end of 1928 some 2,700,000 tons had been milled yielding 957,000 ounces of fine gold.

RANDFONTEIN ESTATES.—A long-established mine in the west—26 miles from Johannesburg. A part of its equipment is a mill of 600 stamps—one of the largest under one roof in the world. It has a capacity of 215,000 tons per month and to the end of 1928, 44,700,000 tons had been milled yielding 12,700,000 ounces of fine gold.

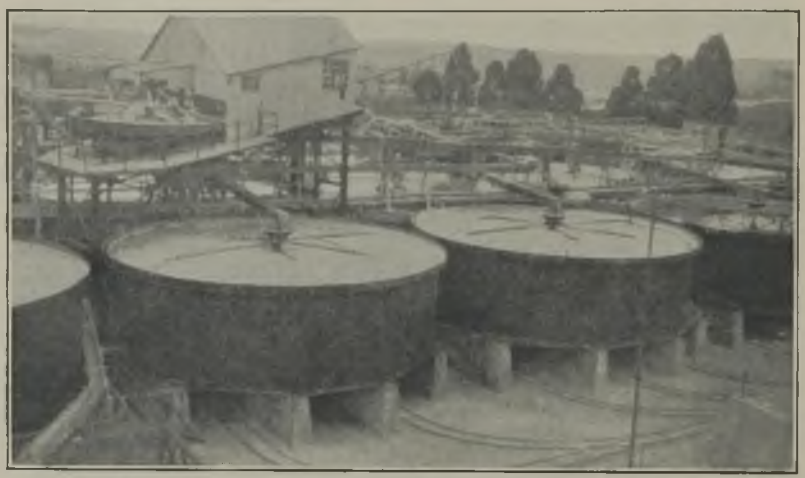
It was not possible within the short period of the stay in Johannesburg for those taking part in the Congress to visit all of these properties but convenient arrangements were made by which a number of parties were enabled to see those for which they had a particular interest or which, in point of distance, could be visited in conjunction



TUBE-MILLS AT CROWN MINES.

with the visits to many other establishments, apart from the actual mines, for which arrangements had been made.

In addition to these visits, however, an important side to the proceedings was, of course, the presentation and discussion of papers at the Sessional Meetings. At one of these meetings a paper was read by Dr. H. A. White on the "Gold Metallurgy of the Witwatersrand Banket Ores" and by way of indicating a little more closely the actual trend of metallurgical practice on the Rand one cannot do better than quote from this paper in which Dr. White describes the advances in practice which have been made since he contributed his admirable paper to the Empire Congress in London in 1924. These two papers, in fact, taken together with his Presidential Address to the Chemical, Metallurgical and Mining Society of South Africa in August, 1925, constitute a valuable epitome of the position and trend of metallurgical practice on the Rand.



Leaching Plant: Crown Mines.

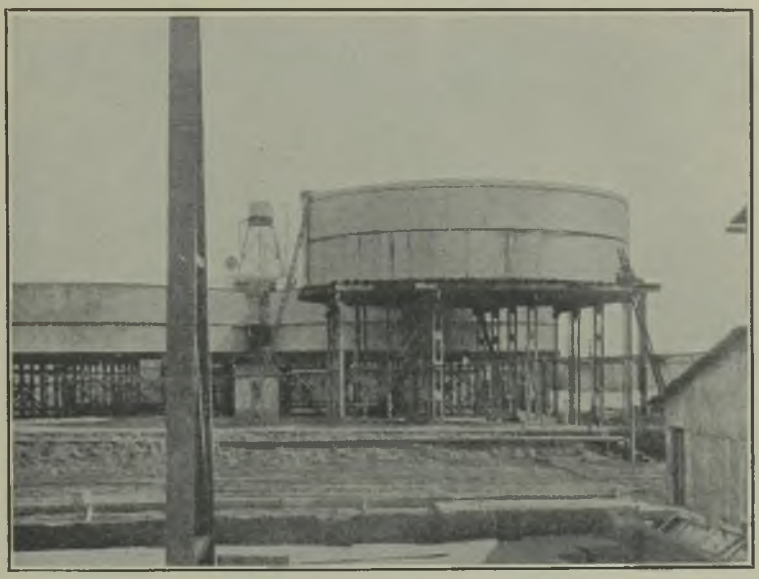
In the paper presented to this Congress he points out that the narrowing field of possibilities in regard to economies necessarily limits the scope for any striking increases in percentage of extraction or in a reduction of working costs. The elimination of stamp mills from future reduction plants will, he thinks, in part be made up by cone-crushers running at great speed and reducing 45/60 tons per hour to pass an inch mesh. Two new types of such crushers have been favourably reported upon. The supply of pebbles required to maintain the tube-mill loads has been furnished in the newer plants by mechanically removing suitable pieces from the ore either by trommels or by grizzlies. The tube-mills or the crushers are likely to fulfil most of the functions hitherto performed by heavy stamps and it is unlikely, he thinks, that any more will be installed. Where extensions have been made in existing plant the number of stamps has remained unchanged.

Amalgamation, as applied to the whole of the mill pulp, he says, has now completely disappeared. As applied to concentrates it still has certain advantages, especially in such cases where the osmiridium content is sufficient to warrant the cost of extraction.

He deals with problems arising from tube-mill practice both in regard to the mills themselves and also in regard to the materials undergoing treatment. The general tendency in the newer plants is towards finer grinding approaching a reduction of 90% −200 mesh in the final pulp. This is being rendered possible by the reduction of the cost of electrical power to 0·45d. per unit and by the more efficient use of tube-mills and their feeding appliances. Dr. White gives a figure of 0·3 ft. lb. per square inch of surface produced by the most efficient tube-mills, while he states that stamp-mills require twice and coarse rock breakers more than four times that amount. But for their cost, steel balls would offer many advantages. Even now they are regarded as economically possible in certain cases of very fine grinding.

With regard to the cyanide plants he records the gradual disappearance of separate treatment for sands unless they are required for underground support. An experimental

plant at Modder Deep for the flotation of the pyritic portion from the sand yielded a satisfactory extraction, but the subsequent treatment of the tails was complicated by the presence of the flotation re-agents. In this connexion Dr. White makes the striking statement that "every year more than 100,000 tons of recoverable pyrites is thrown on to the dumps and dams". He deplores the lamentable waste of this potentially valuable by-product. In regard to the Slime Plants he records the use of improved Dorr collectors to give continuous separation from excess water followed by Dorr agitators in which the gold is extracted.



Cyanide Tanks at West Springs.

Comparisons have been made between filters of the Oliver and American type for removing the gold solutions. Perfect clarification is now well-recognized as of prime importance before passing the solutions on to the precipitation plant. The addition of lead nitrate, which is essential when zinc dust is used for precipitation, is made before the solutions reach the sand clarifiers in order that any traces of basic lead carbonate may be removed. From the clarifiers the solutions pass directly and without storage to the Crowe vacuum apparatus. This obviates any risk of choking the filter cloths of the Merrill presses or filter vats by the precipitation of basic salts which is apt to occur during storage.

The triangular shaped type of Merrill filter press is now being succeeded by an improved type in which the filter leaves are suspended radially round a circular vat. Extreme fineness of the zinc dust has been shown to be a desirable factor. The plea, which Dr. White has made on previous occasions, for a procedure in regard to the periodical "clean-up" which involves less handling of the gold slimes has now been partially met by the installation of this new form of filter vat apparatus.

In concluding this portion of the review of metallurgical activities in South Africa, one may perhaps form some idea of the magnitude of the operations which have already been carried out on the Witwatersrand, as far as mere figures are able to convey such an idea, when one learns that these mines treat over 30,000,000 tons of ore each year and that the total rock which has been hoisted to date is about 750,000,000 tons. Of this quantity some 650,000,000 tons have been milled with an average gold return of slightly under 7 dwt. per ton. This represents some 9,200 tons of gold, valued at approximately £1,000,000,000, to which must be added 1,000 tons of silver and some 30,000 ounces of osmiridium.

(*To be continued.*)

University of London.—A course of four lectures on "Supports for Underground Workings in Coal Mines," by Dr. M. A. Hogan, of the Safety in Mines Research Board, is to be given at the Royal School of Mines on December 8, 9, 10, and 11, at 5.30 p.m.

THE ROAN ANTELOPE COPPER MINE

By A. G. McGREGOR

A description of the mine, mill, and smelter of what will be the first of the newly-developed copper mines in Rhodesia to reach the production stage.

GENERAL.—The rapid development of the copper area which lies adjacent to the Northern Rhodesian-Belgian Congo border has been without doubt the outstanding event of the past decade in the mining world. The period of intense activity in surveying and prospecting is now passing, however, and attention is focussed on those properties which are approaching the production stage. Of these, the Roan Antelope mine will be the first and the description of the mine, mill and smelter equipment of this property, which is given here, will, it is felt, be of general interest to readers of the MAGAZINE. The underground development and plant construction which have been in progress during the past two years at the mines are now rapidly approaching completion.

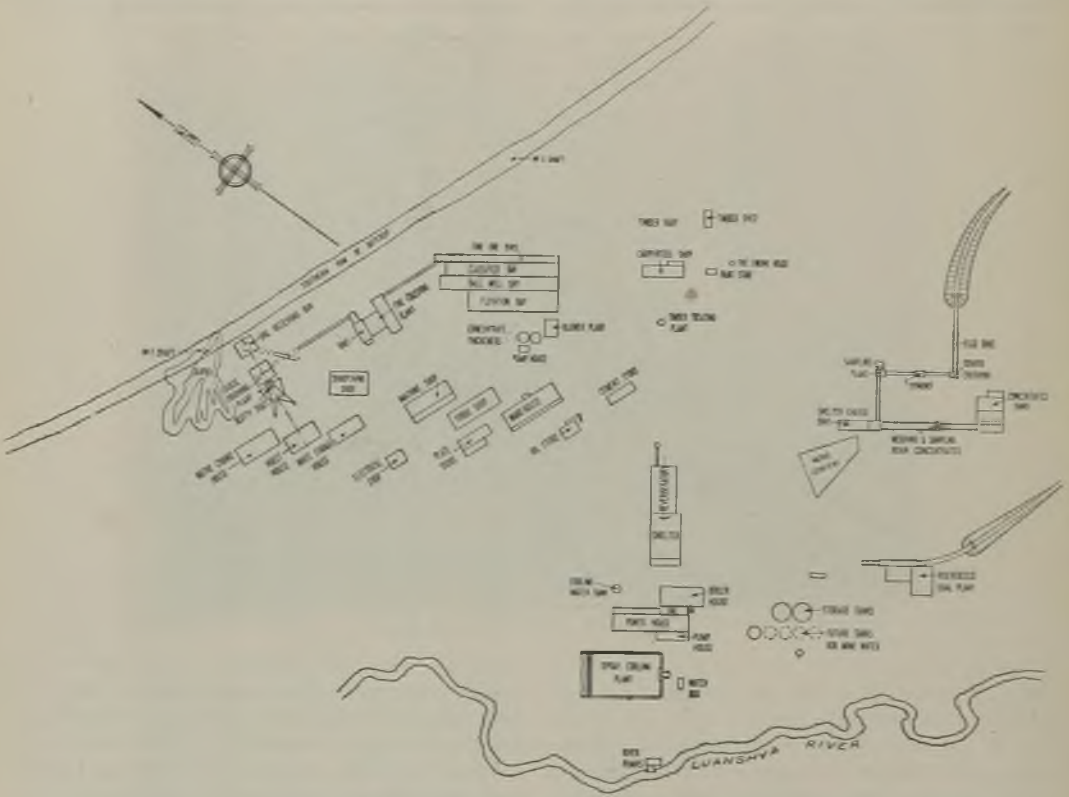


FIG. 1.—GENERAL LAY-OUT OF MINE BUILDINGS WITH RESPECT TO ORE-OUTCROP AND MAIN SHAFT.

GEOLOGY.—The Roan Antelope mine has been opened up in a series of conglomerates, arkoses, felspathic quartzites, argillaceous sandstones, dolomitic shales and dolomite, known as the Roan Series, which, at the mine, form the nose of a syncline pitching north of west. Of this ore-bearing series, it is not the same rock which is mineralized in each of the Northern Rhodesian mines. At the Roan Antelope the host rock is a dense compact dolomitic argillite, which has a very deceptive appearance, mineralization only being apparent on close examination. The ore-minerals occur as grains of chalcocite and bornite disseminated throughout the argillite.

THE MINE.—The property is being developed for an initial production and treatment of 2,000,000 tons of ore yearly, averaging 3·3% sulphide copper, to produce about 50,000 short tons of copper. When the work of development and construction started, the ore-body containing 30,000,000 tons of ore averaging 3·3% sulphide copper, was proved. This block of ore occupies a distance along the axis of the ore-body of

about one mile, and it now proves to be but the eastern tip of an ore-body at least six miles in length. The portion of the ore-body now being developed is shaped like one end of a canoe having rounded bottom and end. Both limbs of this synclinal trough outcrop at the surface about 1,800 ft. apart, and the bottom is about 1,200 ft. below the surface. The surface of the ground over the ore-body may be considered as comparatively flat and level.

The Beatty Shaft.—The Beatty shaft, which will be the main hoisting shaft, is located about one half mile from the extreme eastern end of the ore-body, and the shops, warehouse, crushing plants, mill, smelter and main power plant are located in fairly close proximity to this shaft, which places all of the surface plant near the eastern end of the ore-body as may be seen from the lay-out diagrammatically shown in Fig. 1. In Fig. 2 is shown a development steel headframe and bin at No. 2 Shaft.

Fig. 2.—Development Steel Headframe at No. 2 Shaft.

Underground, the ore is being developed for sub-level stoping, a general plan of the stope arrangement being shown in Supplement No. 1. On the south limb, at the 420-foot and 620-foot levels, the ore lies at an angle of about 40° with the horizontal, and the haulage drives are in the foot wall. The north limb lies steeper at these levels, and it is practical to locate the haulage drives in the ore strata. Figs. 3 and 4 indicate the mining methods for ore dipping at less than 40° and greater than 50° respectively.

The ore will be drawn from the chutes (Fig. 5) into Granby type cars of 5-tons capacity. Ninety-seven of these cars have been ordered, and 40 more will be ordered later. In Fig. 6 is shown the general design of car being used.

The gauge of the haulage tracks is 30 in. Ten storage battery locomotives have been ordered, having a total weight each of 14,000 pounds, for gathering and making up the ore-trains. Four trolley locomotives, having two 50 h.p. motors each, and a total weight each of 16,000 lb., are being provided for the main haul to the shaft.

The cars dump on grizzlies having 18 in. openings over the skip pockets (Fig. 7). The skips hold ten tons of ore. The drawing (Fig. 8) shows the dimensions of the rectangular steel-timbered shaft. The main cage is double decked and has platforms 7-ft. by 12-ft.

The ore-winder has double cylindrical drums, one drum fixed, one drum with clutch, the drums being 14 ft. 6 in. in diameter by 5 ft. 3 in. face, and grooved for $6\frac{3}{4}$ in. circular flattened-strand wire rope. The rope speed is 1,400 f.p.m., and the output of the winder 500 tons per hour. The winder has a Ward-Leonard control and the winder motor is

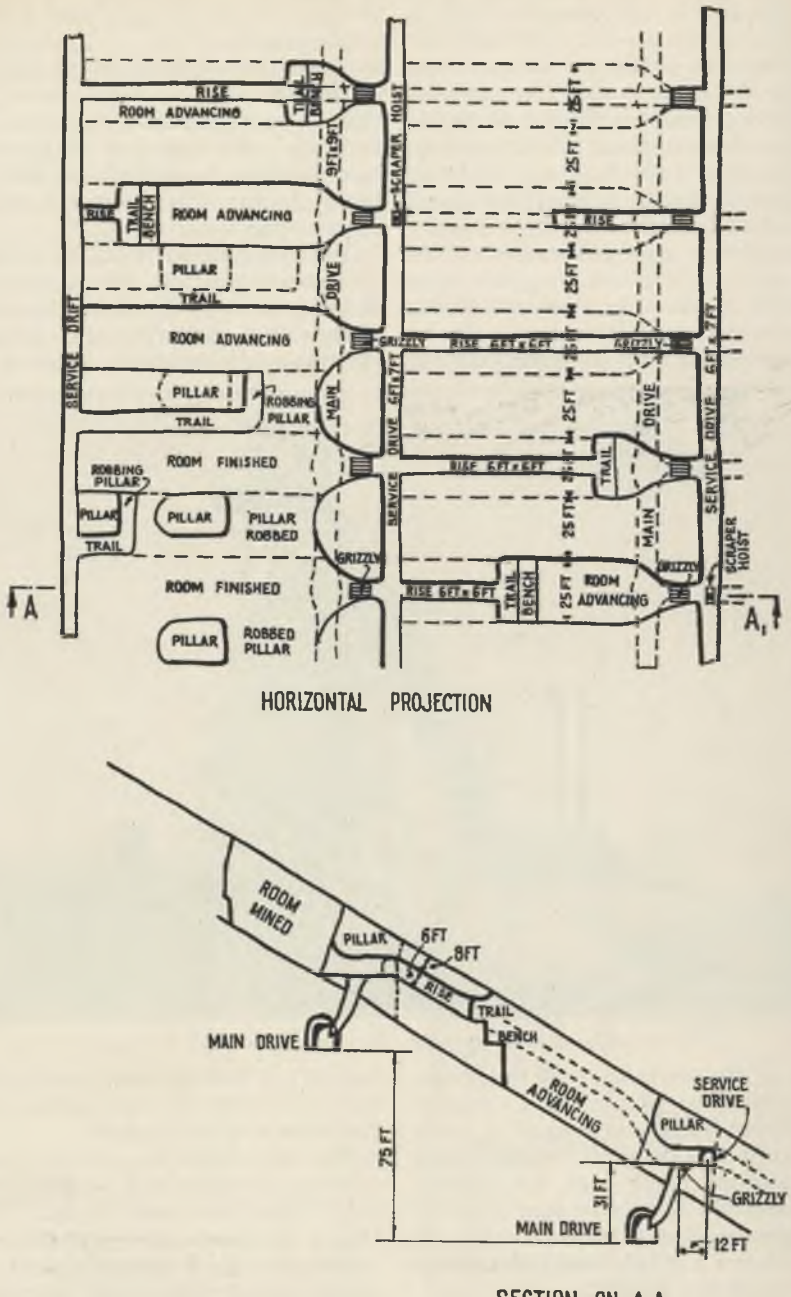
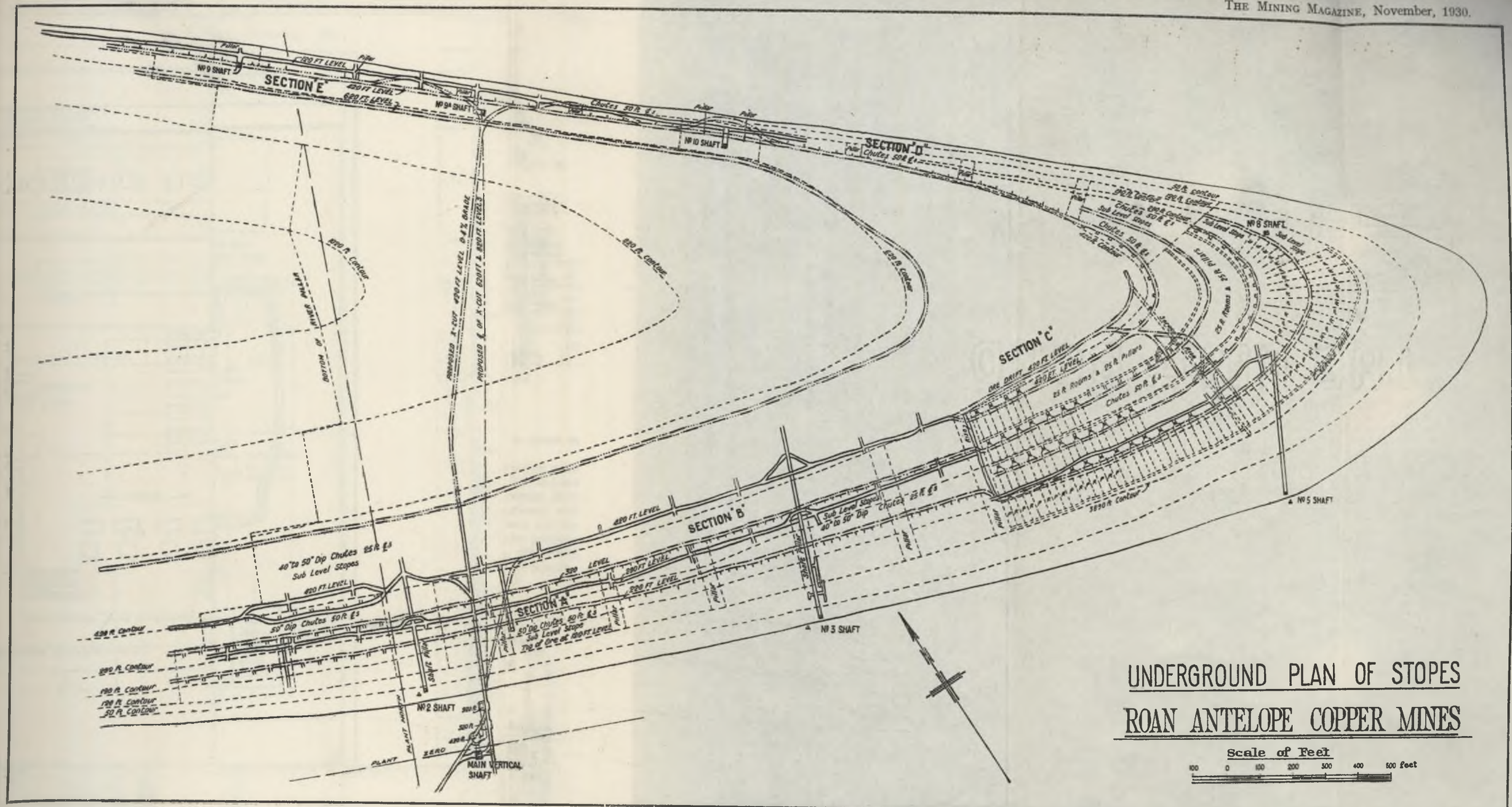


FIG. 3.—METHOD OF MINING FOR ORE DIPPING AT LESS THAN 40°.

rated at 1,290 h.p., while the motor generator flywheel set is rated at 896 k.w.

The man-winder has double cylindrical drums, both drums being fixed to the shaft, their size being 16 ft. 6 in. diameter by 5 ft. 2 in. face, and grooved for $7\frac{3}{4}$ in. circular flattened-strand wire-rope. The rope speed is 1,600 f.p.m., and the output is 3,850 men per hour. The winder has a Ward-Leonard control, the winder motor being rated at 1,290 h.p. The motor generator flywheel set is rated at 896 k.w. The electrical equipment of the two hoists is interchangeable and special switches and connexions are provided


SECTION 'E'
SECTION 'D'
SECTION 'C'
SECTION 'B'
SECTION 'A'
No 9 SHAFT
No 9a SHAFT
No 10 SHAFT
No 6 SHAFT
No 5 SHAFT
No 3 SHAFT
No 2 SHAFT
MAIN VERTICAL SHAFT
1200 FT. LEVEL
820 FT. LEVEL
620 FT. LEVEL
420 FT. LEVEL
320 LEVEL
220 FT. LEVEL
Pillar
Chutes 50 ft. ℄
Sub Level Stopes
40° to 50° Dip Chutes 25 ft. ℄s
50° Dip Chutes 50 ft. ℄s
50° Dip Chutes
Sub Level Stopes
Top of Ore at 820 FT. Level
One Drift 420 FT. Level
25 ft. Rooms & 25 ft. Pillars
3890 ft. Contour
820 ft. Contour
620 ft. Contour
420 ft. Contour
320 ft. Contour
220 ft. Contour
50 ft. Contour
PROPOSED R. CUT
PROPOSED N. & W. CUT
PLANT MAIN
PLANT
ZERO
UNDERGROUND PLAN OF STOPES
ROAN ANTELOPE COPPER MINES
Scale of Feet
100 0 100 200 300 400 500 feet

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ORE SKIP
WASTE BIN
R.I.V. DRIVE
No. 7C ROSS FEEDER
48" NELSON GRIZZLEY
TWO GYRATORY No. 30 MC-CULLY CRUSHERS. TOTAL CAPACITY 600 TONS PER HOUR
42" BELT CONVEYOR CAPACITY 600 TONS PER HOUR
THROW-OFF CARRIAGE
BIN 3000 TONS CAPACITY
4' DIAM ADJUSTABLE ROLL FEEDER
5 @ 4'-0" x 6'-0" HUMMER ELECTRIC SCREENS TYPE 60
OVERSIZE
UNDERSIZE
42" BELT CONVEYOR CAPACITY 600 TONS PER HOUR
42" BELT CONVEYOR WITH THROW-OFF CARRIAGE CAPACITY 600 TONS PER HOUR
FINE ORE BINS 6000 TONS TOTAL CAPACITY
No. 1 SECTION 1200 TONS
No. 2
No. 3
No. 4
No. 5
6 @ 18" DIAM. ROLL FEEDERS

BEATTY SHAFT
MINE ORE 600 TONS PER HOUR
ORE BIN 3000 TONS CAPACITY
2 @ 54" BELTS 75 FT/MIN 600 TONS MAKE UP TOTAL CAPACITY PER HOUR
WEIGHTOMETER
42" BELT CONVEYOR
42" BELT CONVEYOR
WEIGHTOMETER
5 @ 24" BELT CONVEYORS CAPACITY 120 TONS PER HOUR EACH TOTAL 600 TONS PER HOUR
5 @ 5½ FT. SYMONS CONE CRUSHERS

— MINE ORE TO FINE ORE BINS —

No. 1 SECTION BIN 1200 TONS CAPACITY
ALTERNATIVE FLOW
WEIGHTOMETER
TWIN CORN BOWL CLASSIFIERS 9 S.D. 12'-0" x 3'-0" 18'-0" DIAM
INTERMEDIATE CLASSIFIER
SECONDARY CLASSIFIER
SAMPLER
SAMPLER 1200 TONS GROUND ORE PER 24 HOURS
SAMPLER
CLASSIFIER SANDS
No. 1 SECTION No. 2 No. 3 No. 4 No. 5
ALTERNATIVE SLIME FLOW
CLASSIFIER SANDS
No. 9B MARCY BALL MILL (PRIMARY)
No. 9D MARCY BALL MILL (SECONDARY)
DORR CLASSIFIER 6 S.D. 20'-0" x 12'-0" (PRIMARY)
4'-6" RADIUS ELEVATING SCOOPS
3 @ 6" WILFLEY SAND CENTRIFUGAL PUMPS

— FINE ORE TO PULP —
ONE GRINDING SECTION
CAPACITY 1200 TONS PER 24 HOURS
TOTAL 5 SECTIONS

BOWL CLASSIFIER OVERFLOWS
SAMPLER
SPLITTER
SPARE PUMP
2 @ 8" WILFLEY SAND CENTRIFUGAL PUMPS

— REFERENCE —

MINE ORE	
GROUND PULP	
PRIMARY ROUGHER FROTHS TO PRIMARY CLEANERS	
PRIMARY ROUGHER TAILS TO SECONDARY ROUGHERS	
SECONDARY ROUGHER TAILS (TAILINGS) TO 250' TRACTION THICKENER	
PRIMARY CLEANER FROTHS TO SECONDARY CLEANERS	
PRIMARY CLEANER TAILS TO PRIMARY ROUGHERS	
SECONDARY CLEANER FROTHS (FINISHED CONCENTRATE) TO 35' THICKENERS	
SECONDARY ROUGHER FROTHS TO PRIMARY ROUGHERS	
SECONDARY CLEANER TAILS TO PRIMARY CLEANERS	
WATER	
LOW PRESSURE AIR	

8 ROOTS BLOWERS TYPE 6½-22 x 49½ CAPACITY EACH 12,500 C.FT. FREE AIR PER MIN AT 2 LBS. PRESSURE

RETURN MILL WATER FROM THICKENERS & DAM
CONCENTRATE THICK^R OVERFLOWS
2 @ 250 G.P.M. WATER PUMPS
3 CONCENTRATE STORAGE TANKS 10' DIAM x 10'-0"
12 @ 2'8" OLIVER FILTERS AND PUMPS
FINISHED CONCENTRATE TO DRYERS
BOWL CLASSIFIER OVERFLOWS TO PRIMARY ROUGHERS
PRIMARY CLEANER TAILS TO PRIMARY ROUGHERS.
PRIMARY ROUGHER FROTHS TO PRIMARY CLEANERS
FINISHED CONCENTRATES TO 35' THICKENERS
UNDERFLOWS
2 @ 35 FT. x 10 FT DORR THICKENERS
2 @ 2" WILFLEY CENTRIFUGAL SAND PUMPS
FILTER EFFLUENT
SECONDARY ROUGHER FROTHS TO PRIMARY ROUGHERS
2 @ 6" WILFLEY CENTRIFUGAL SAND PUMPS
SAMPLER
SECONDARY ROUGHER FROTHS TO PRIMARY ROUGHERS
4 @ 6" WILFLEY CENTRIFUGAL SAND PUMPS
SECONDARY CLEANER TAILINGS
3 @ 4" WILFLEY CENTRIFUGAL SAND PUMPS
PRIMARY CLEANER FROTHS TO SECONDARY CLEANERS
2 @ 4" WILFLEY CENTRIFUGAL SAND PUMPS
2 @ 6" WILFLEY CENTRIFUGAL SAND PUMPS
SAMPLER
PRIMARY ROUGHER FROTHS
SAMPLERS
SAMPLERS
LOW PRESSURE AIR FROM BLOWERS
60 FT. MATLESS FLOTATION MACHINES TYPE "HB 3660" PRIMARY ROUGHER SECONDARY ROUGHERS
22 FT. DO. DO. DO.
10 WAY DISTRIBUTOR
5 - WAY DISTRIBUTOR
5 - WAY DISTRIBUTOR
TAILINGS
TAILINGS
TAILINGS
TEST SECTION TAILINGS
SAMPLERS
TAILINGS TO 250' THICKENER
2 @ 7,000 G.P.M. WATER PUMPS CAPACITY 100,000 GALS
MILL WATER SUPPLY TANK
2 @ 1000 G.P.M. WATER PUMPS
OVERFLOW
250 FT. DIAM DORR TRACTION THICKENER
UNDERFLOW
WATER PUMPS AT POWER HOUSE
3 @ 6" WILFLEY CENTRIFUGAL SAND PUMPS
TAILINGS DAM
RETURN WATER FROM DAM.

— COMPLETE FLOTATION UNIT —
CAPACITY 6000 TONS PER 24 HOURS

CONCENTRATOR FLOW-SHEET, ROAN ANTELOPE COPPER MINES.

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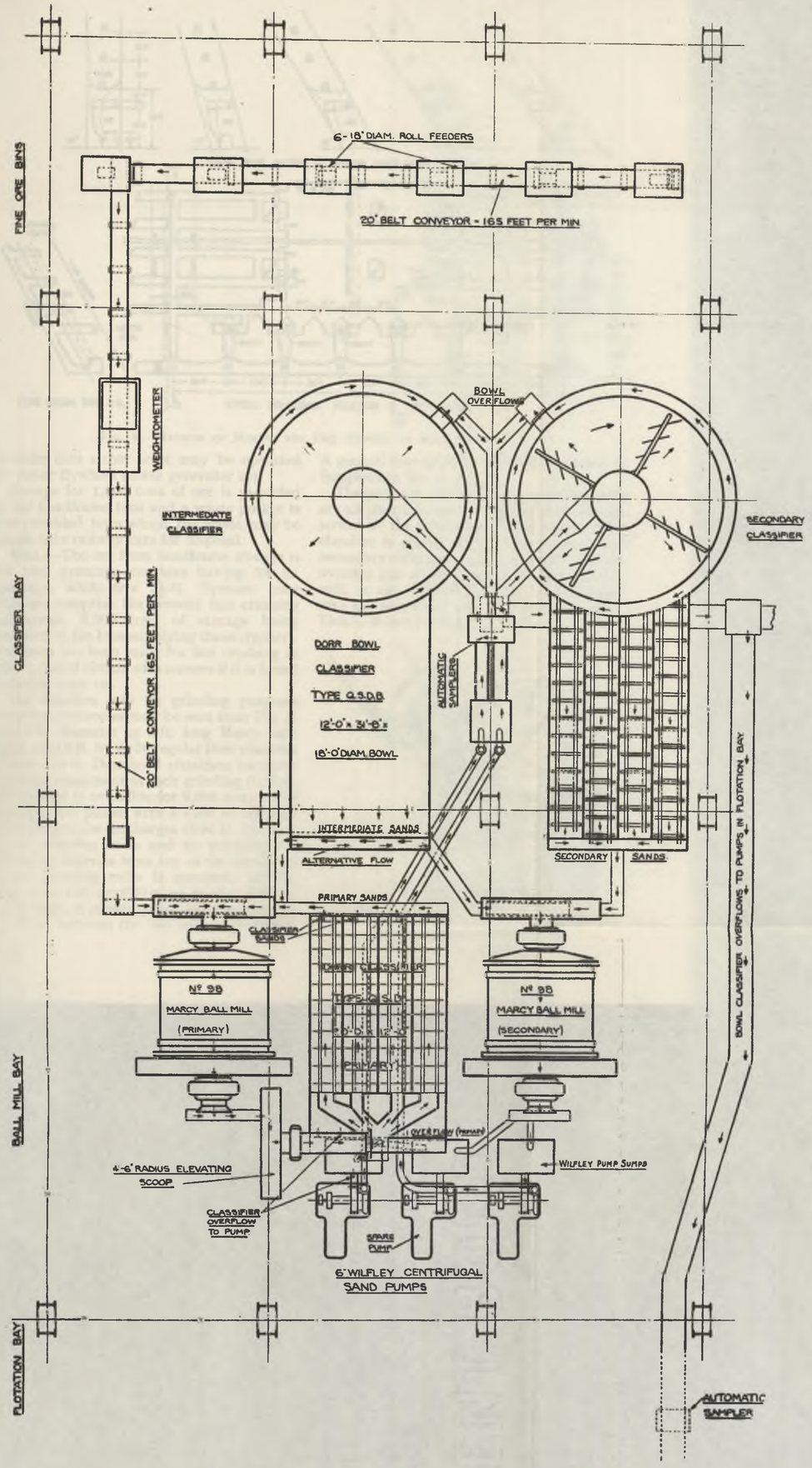

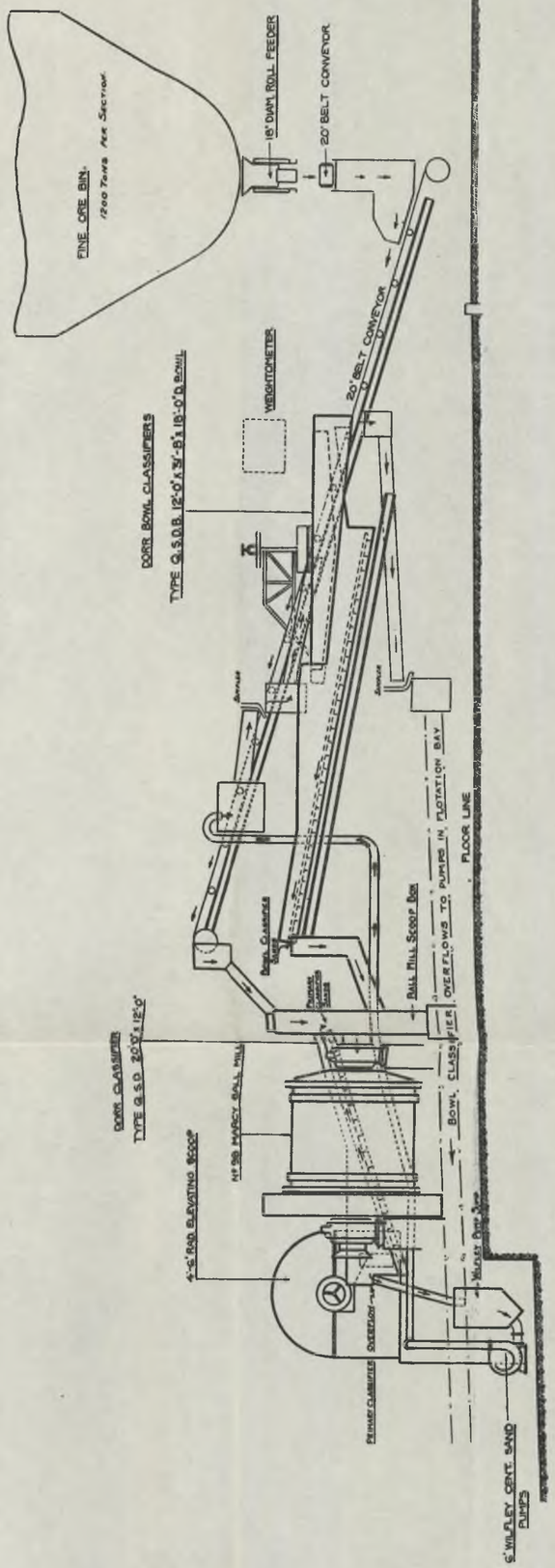

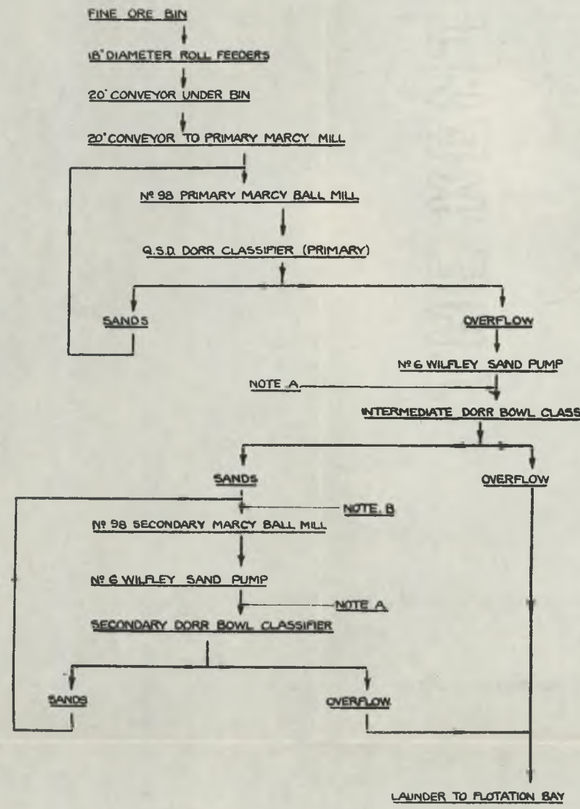

NOTE A — THE FLOW OF THE WILFLEY SAND PUMPS CAN BE JOINED AND THE DORR BOWL CLASSIFIERS RUN IN PARALLEL

NOTE B — THE SANDS OF THE INTERMEDIATE DORR BOWL CLASSIFIER MAY BE SENT IN PART OR WHOLLY TO THE PRIMARY MARCY BALL MILL

FLOW-SHEET AND LAY-OUT OF BALL-MILLS AND CLASSIFIERS, ROAN ANTELOPE COPPER MINES.

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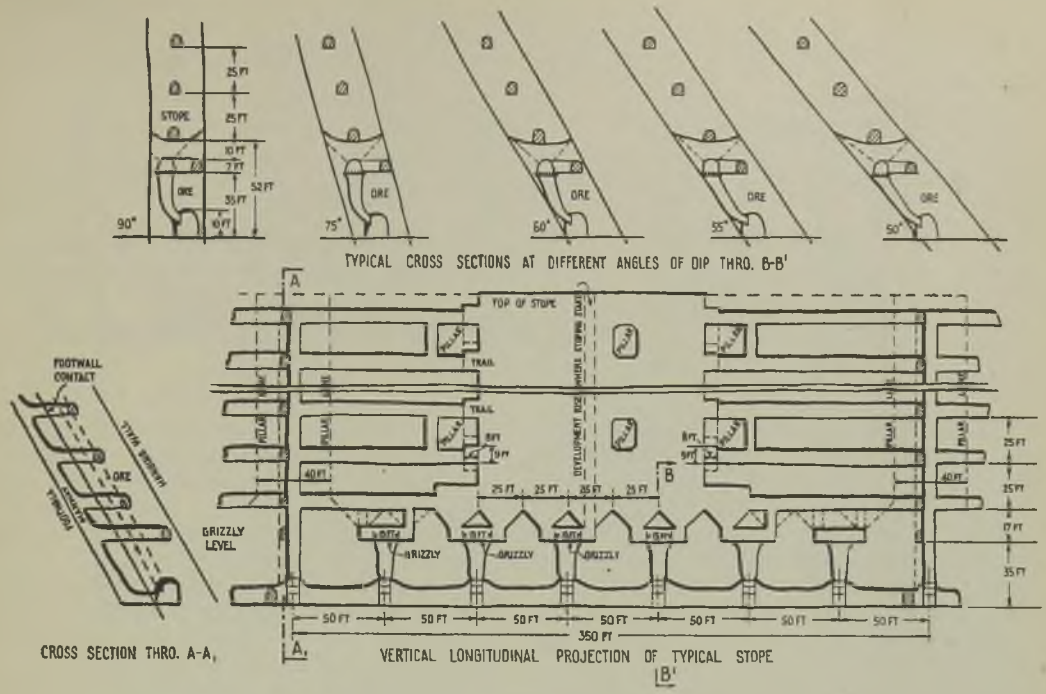


FIG. 4.—METHOD OF MINING FOR ORE DIPPING AT MORE THAN 50°

in order that either hoist may be operated by either flywheel motor generator set.

Storage for 1,600 tons of ore is provided in the headframe bins and a waste pocket is also provided from which the waste may be drawn into railway cars for disposal.

MILL.—The ore from headframe storage is fed into gyratory crushers having 24 in. openings, while five 5½-ft. Symons cone crushers comprise the present fine crushing equipment, 3,000 tons of storage being provided in the bins supplying these crushers. Provision has been made for fine crushing in rolls in closed circuit with screens if it is found desirable later on.

The flotation mill for grinding purposes is in five sections as may be seen from Fig. 9. Two 9-ft. diameter by 8-ft. long Marcy ball-mills, one 12-ft. by 20-ft. regular Dorr classifier and two 18-ft. Dorr bowl classifiers comprise the main equipment in each grinding section. Ore storage is available for 6,000 tons. The classifiers are placed with a view to bringing all their oversize discharges close to the inlet of the grinding mills and no pumping for delivering oversize from any of the classifiers to the grinding mills is required. At the same time full flexibility as to the division of the work of grinding the oversize from the classifiers between the two mills is provided. A general flow-sheet of the mill is shown in Supplement No. 2.

The primary and secondary grinding mills are all placed in one row side by side, and are served by the same crane. The regular Dorr classifier is placed between the primary and secondary mills in each grinding unit, and the oversize can all be returned to the primary mill, or any desired part can be discharged into the secondary mill directly by gravity. This is shown in Supplement No. 3.

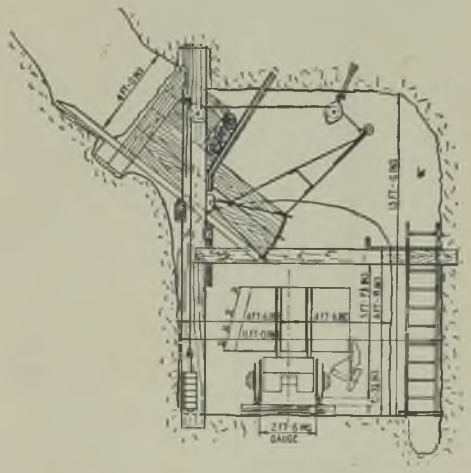


FIG. 5.—DESIGN OF ORE-CHUTE.

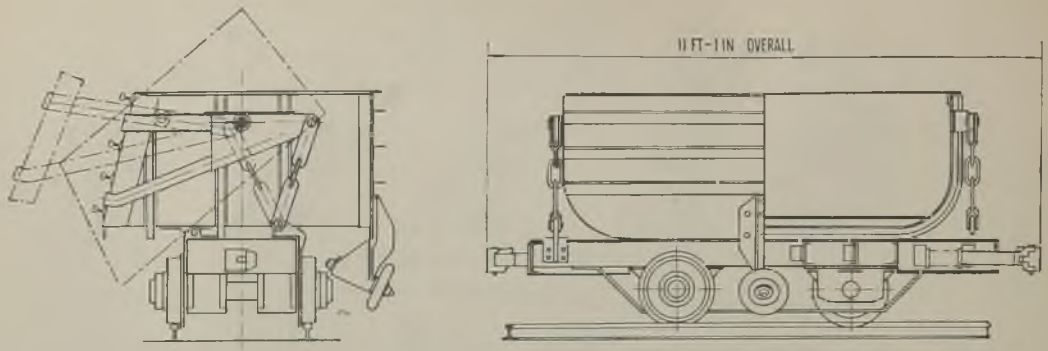


FIG. 6.—TYPE OF MINE CAR WHICH WILL BE USED UNDERGROUND.

The overflow of the primary classifier can be delivered to one bowl classifier, or distributed in any desired proportion to the two bowl classifiers. The secondary mill can be discharged into one or both bowl classifiers and the oversize from one of the bowl classifiers can be discharged direct by gravity to either or both grinding mills in any desired proportion.

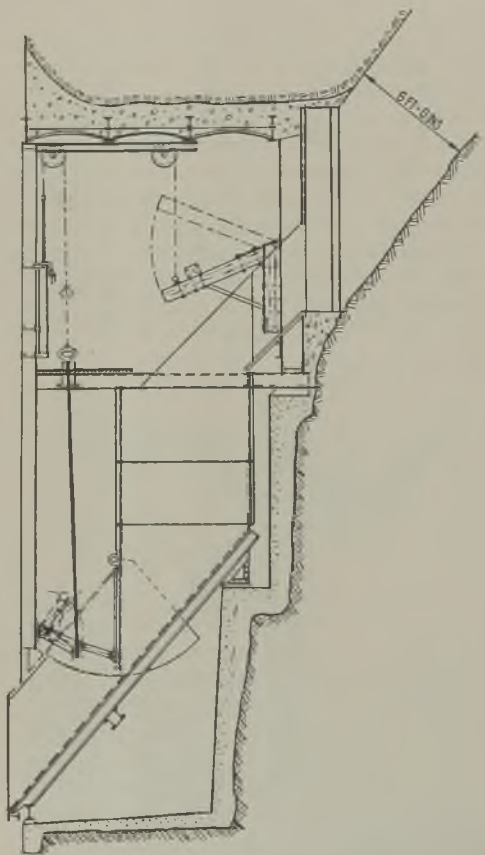


FIG. 7.—ORE-MEASURING POCKET.

For the flotation, Forrester Hunt matless air-agitation cells will be used—820 lineal feet of primary and secondary roughers, and 190 lineal feet of cleaners. The air blowing equipment consists of eight 12,500 cu. ft. per minute Roots high speed blowers.

The concentrate, amounting to about 380 tons per day of concentrate assaying 55% Cu. will be thickened in Dorr tanks, two 35-ft. by 10-ft. thickeners being provided.

Three 8-ft. by 8-ft. Oliver filters with their 16-ft. diameter by 10-ft. stock tanks are being installed at the smelting plant. The Dorr tailings thickener is 250-ft. in diameter.

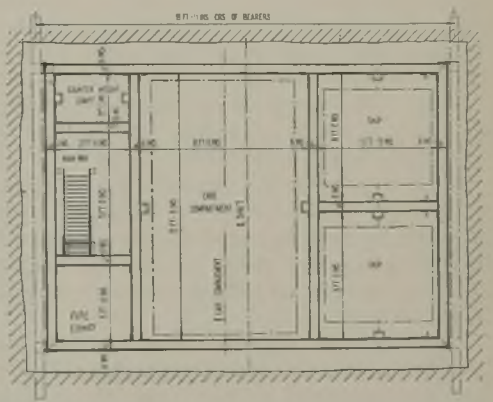


FIG. 8.—DIMENSIONS OF STEEL-TIMBERED SHAFT.

SMELTING PLANT.—The three Oliver filters are being mounted at the head end of Lowden dryers and will act as feeders for the dryers. Owing to the fineness of the concentrate and its alumina content, it was thought advisable to dry the concentrates. Before delivering to the smelter-charge bins the dried concentrates are sampled and then weighed by a special hopper scale which receives and discharges the weighed batches by belt conveyors.

For receiving and preparing coarse ores

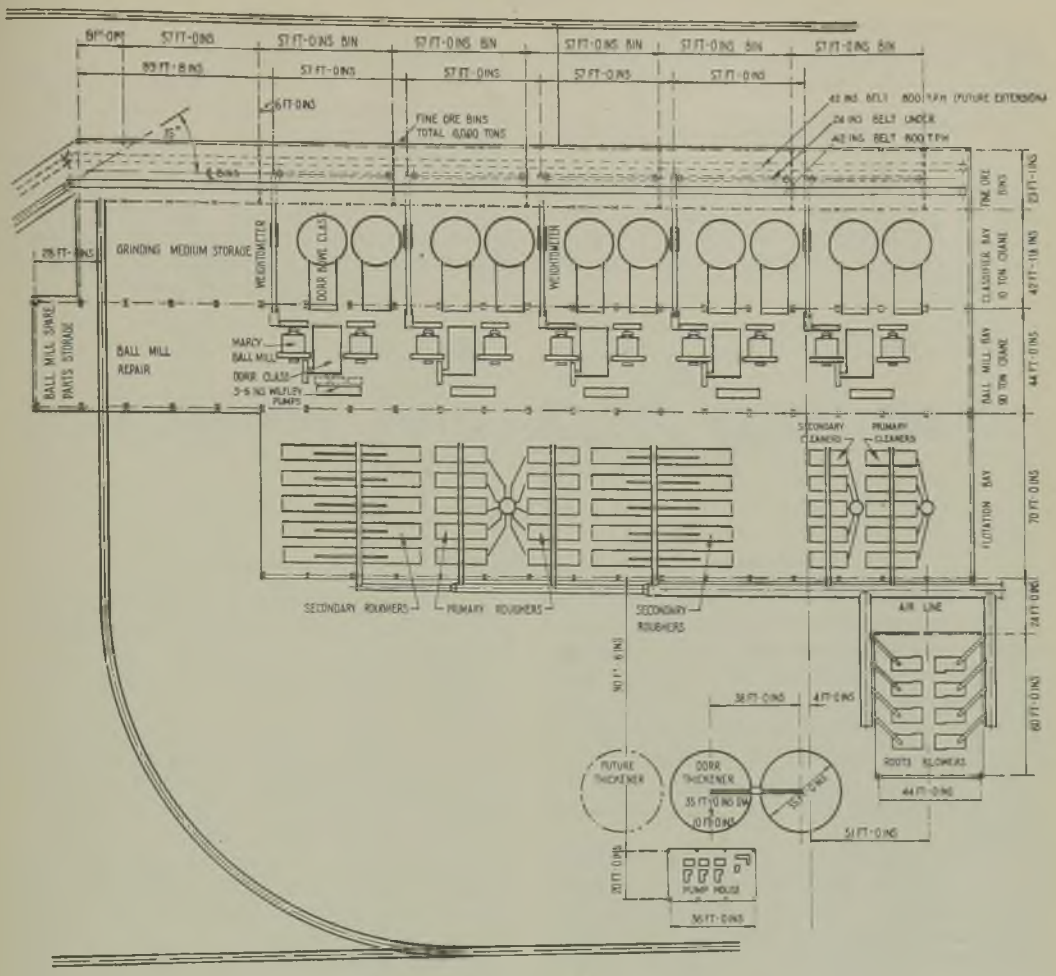


Fig. 9.—Diagrammatic Plan of Mill.

and fluxes, receiving bins, a 15 in by 24 in. Blake type crusher, a 5½-ft. Symons cone crusher, one set of 42 in. by 16 in. rolls and a small sampling plant are provided.

The concentrates and fluxes will be fed out of the charge bins in the proper proportions for the furnace charge by apron-feeders into a weighing larry car. The body of the charge-car is drum-shaped and arranged to rotate like a concrete mixer for mixing the furnace charge as the charge is being hauled from the charge bins to the furnace. This weighing and mixing car delivers the charge to a 20-ton hopper from which it is fed by a pan feeder under the control of the furnace operator, and distributed over the charge holes along each side of the furnace.

One reverberatory furnace, 25-ft. by 120-ft., is being provided for the present. It will have a waste-heat boiler and air preheater. The furnace will have its own stack, 9-ft. by 180-ft. Two 12-ft. by 20-ft. converters are being installed, one being spare. In addition, a 12 ft. 2 in. by 31 ft. 7 in. refining furnace with a casting machine will be used for making fire-refined wire-bars, ingots, and cakes, as the ore to be mined for the first few years is unusually free from the elements which make electrolytic refining necessary.

The fuel used at the reverberatory and refining furnaces will be powdered coal. Wankie slack or lump coal will be delivered to a central pulverizing plant (Fig. 9) having one SX4 Trojan crusher, two 7 ft. 6 in. by 55-ft. dryers and three 5-ft. by 8-ft. grinding mills. This pulverizing plant will also prepare the coal for the boilers of the main power plant.

The power plant is located conveniently to the reverberatory furnace waste-heat boilers and its main equipment consists of the following :—

2 7,000 k.w. turbo-alternators, 3,300 volts, 50 cycle.
1 1,000 k.w. turbo-alternator.
2 Electric driven air-compressors, 3,000 cu. ft. capacity each, for 90 lb. air.
2 Air-compressors 5,000 cu. ft. capacity each.
4 774 h.p. Stirling boilers with Bailey water cooled furnaces.

The plant has well-equipped machine, boiler, blacksmith and electric repair shops and a carpenter's shop.

Every department of the mine and mill plant can be readily extended to three times the initial capacity, and the smelting plant, which will later treat the Mufulira concentrates also, can be readily extended to five or six times its initial capacity.

SOME NOTES ON CRUSHING, MIXING, AND REDUCING SAMPLES

By E. G. WILKINS, A.I.M.M.

The author gives an account of sampling methods useful in remote places.

The method of mixing and quartering samples described in this article will be found useful in an out-of-the-way district where no machinery is available for crushing down and " quartering " the samples. The method is old and efficient, but is sometimes forgotten owing to the conveniences nowadays usually found at well equipped mines. It is for the younger engineer that these notes are written.

The method was lately used by the author in the sampling of a gold mine in Roumania, where the ore was an andesite-porphyry containing stringers of quartz. The number of samples taken in this instance was about 200.

The following equipment was used in the work :—

4 heavy canvas sheets (Cotton Duck 13 oz.) 5 ft. by 7 ft.
4 heavy canvas sheets (Cotton Duck 13 oz.) 4 ft. by 6 ft.
4 heavy canvas sheets (Cotton Duck 13 oz.) 3 ft. by 4 ft.
4 heavy canvas sheets (Cotton Duck 13 oz.) 8 ft. by 6 ft.
1 ground-sheet (rubber on one side) $4\frac{1}{2}$ ft. by 6 ft.
2 whisk brooms (large size).
2 wire scrubbing brushes.
2 flat paint brushes, say, 5 in. wide.
1 flat paint brush (soft), say, $2\frac{1}{2}$ in. wide.
1 Jones Sampler.
1—12 in. Spatula.
2 " Gold Pans " (to punch for use as coarse sieves).
1 dozen frying pans or shallow saucepans (for holding small crushed samples), say 8 in. diameter.
Calico sample bags (with tapes), say, 7 in. by 14 in.
Heavy paper sample bags (for the final reduced samples), say, 4 in. by 12 in.
Heavy canvas bags for shipment of reduced samples, if necessary, say, 26 in. by 17 in.
Strong string, sealing wax, a seal, two or three yale locks, two or three canvas mail bags with eyelets and locks, boxes, pans, etc., for catching samples (aided by the canvas sheets), moils, hammers, etc.

At the Roumanian gold mine on which this method was used, the samples were taken as nearly as possible at intervals of two metres. The upper workings had been mostly stoped out, so that most of the samples were taken from the floor of the lower workings. The wire brushes were used thoroughly to clean the floor before the samples were taken. The weight of the samples varied from 15 to 30 kilos. per metre of sample cut, an average of about 20 kilos., which represents a cut about 5 cm. deep by 15 cm. wide. The mine had been under water for many years which made the ore fairly easy to break.

Four men were employed, two working on each sample, and owing to the closeness of the sample cuts it was possible, after the men were well instructed, for one engineer to supervise the cutting of two samples at the same time. The samples, being wet, were sacked underground, brought to the surface

and quickly dried on an improvized stove, made from a large piece of sheet iron supported by stones.

For crushing down, a level place on the ground was selected. Each sample, after drying, was placed on one of the larger sheets of canvas and broken down to about minus $\frac{1}{2}$ in. by two men, using 4 lb. hammers and an anvil made from any available flat piece of heavy iron (new stamp shoes being used in this particular case). It was necessary to have pads of some kind both on the canvas and on the ground, underneath the anvil, in order to keep the canvas from being cut by broken rock fragments. These pads were made by folding pieces from a torn up sack. The two men sat one at each end of the canvas, having pulled it well up over them in order to stop pieces of ore from flying off the sheet. A more effective means was contrived which consisted in placing four stakes about 18 in. to 2 ft. high just outside the mens' knees as they sat on the ground, the stakes being connected along the sides by cross bars on top. The sides of the canvas being thrown over these bars, any pieces of ore were effectively stopped from being lost.

After the sample had been crushed to the desired size it was thoroughly mixed by the two men in the manner about to be described.

The process of mixing requires practice and "knack" to be done properly, but it is quickly learned. The men stand at each end of the canvas and firmly grip the corners of their own end of the sheet, holding them a foot or two above the ground. One man then walks slowly towards the other briskly lifting with each step one corner and then the other of the canvas, in a diagonal direction, thus giving the ore a rolling movement forward and sideways, until the sample is at the other end of the sheet. He then steps back to the starting position and the second man walks forward repeating the process. After each has performed this operation about six times the sample will be found to be thoroughly mixed (as may be readily seen if ores of different colours are on the canvas).

The sample, having been thoroughly mixed, is rolled to the middle of the sheet. One man holds the corners (two in each hand) so that the sheet is doubled and lifts the sample a few inches from the ground, while the other places a round stick, about 1 in. in diameter, crossways on the ground under the sample. The sheet is lowered on to it so that the stick is about in the centre of the sample. The sides of the sheet are dropped and the stick is adjusted to the centre of the sample by a twisting, rolling movement, and is then lifted up, thus completely halving the sample. One half is then thrown away and the canvas on that side thoroughly brushed with a whisk-broom. The other half may be transferred to a smaller canvas if it is not too bulky.

The whole process of crushing, mixing, and halving is then continued, each time throwing away an alternate half, until the sample has been reduced to say 5 kilos. in weight and minus $\frac{1}{4}$ in. size. This may be placed in one of the smaller calico sample bags for shipment, or for further reduction. The further reduction during the sampling by the author was continued by crushing finer and mixing on a sheet about 2 ft. by 2 ft., cut from the rubber ground sheet and halving by means of a Jones sampler, the process being repeated until the sample was small enough to be placed in one of the paper sample bags for shipment. The other half of the last halving was kept as a check. In a dry mine the whole of this process can be conveniently done underground up to the point where the samples are put into the small calico sample bags.

The details of the sampling were tabulated as is shown in the specimen sheet reproduced here.

.....*Mine.*

Level ..... *Working Place* ..... *Sampled by* .....

Date.	No. of Sample.	Distance from	Length represented.	Width of Sample.	Width of Lode.	Description.	Grams Ag per Ton.	Grams Au per Ton.	Totals.		Progressive Totals.			Remarks and Sketches.
			L	W				V	L × W	L × W × V	L × W × V	L × W	L	

THE ANALYSIS OF CRUDE PLATINUM AND PALLADIUM

By W. P. HORNE, A.I.M.M.

INTRODUCTION.—In arranging the following procedure for the analysis of platinum and palladium, two points had to be kept in mind. One was the determination of the platinum or the palladium, the other was the estimation of the base metals as a whole, and of the other precious metals. The grouping of the impurities in this way was of assistance to the refinery in guiding operations.

It may be of interest to note that the samples analysed were from 98% to 99·85% Pt. or Pd., and that samples analysed by independent firms checked closely the figures obtained by the author for these metals.

THE ANALYSIS OF PLATINUM.—Add to 5 gms. of sample in a 250 cc. beaker, 120 ccs. of water, 10 ccs. of nitric acid, sp.gr. 1·42 and 30 ccs. of hydrochloric acid sp.gr. 1·18. Digest on the hot plate over night at 75–80° C. Decant through a 5½ cm. No. 40 Whatman filter paper ; wash residue with hot water by decantation until the washings are colourless, and wash the paper until all colour is removed ; then dry and ignite.

The Filtrate.—Evaporate until just dry and give three evaporations with hydrochloric acid using 25–30 ccs. of hydrochloric acid each time. Take up in a little hydrochloric acid, dilute somewhat (50 ccs.) and add to the cold solution a 1% solution of dimethylglyoxime in alcohol. Stir well, allow to stand until settled, filter, wash with hot water and ignite in a covered crucible. Moisten the residue with formic acid, dry and weigh as Pd. + Pt. Dissolve in aqua regia (dilute), give three evaporations with hydrochloric acid and take up in a few drops of hydrochloric acid. Dilute a little and add a large excess of saturated ammonium chloride solution. Stir well and allow to stand for several hours. Filter off the ammonium platinic chloride, ignite (very cautiously at first) in a covered crucible, and weigh as Pt., which weight is then subtracted from the Pd. + Pt. weight to give the Pd.

The filtrate from the glyoxime precipitation is made slightly alkaline by the addition of sodium carbonate, followed by 30 ccs. of formic acid. The contents of the beaker are brought cautiously to the boil (otherwise the assay may, without warning, rise up over the top) and kept simmering for about half an hour after the liquor is water white. The platinum is then filtered off, and the filtrate again boiled for an hour with a further 10 ccs. of formic acid. Sometimes a trace more of platinum is precipitated and this is filtered off.

The filtrate is made alkaline with ammonium hydroxide, 10 ccs. of yellow ammonium sulphide added, and the liquor boiled for 15 minutes. After standing hot for some time, the base metal sulphides are filtered off, washed, ignited at a low, red heat and weighed. These base metals generally consist of copper, nickel, iron, and lead.

The Residue.—This may contain, in addition to Pt. and Ir. some PdO, which is only very slowly soluble in aqua regia. It is however, readily rendered soluble by previously reducing to metal with formic acid. Treat the residue from the dilute aqua regia extractions in the original beaker, with a few drops of formic acid, and dry on the hot plate. Add 30 ccs. of hydrochloric acid and 10 ccs. of nitric acid and digest for a couple of hours at about 80° C. Evaporate to dryness and give two evaporations with 15 ccs. of hydrochloric acid. Take up in a few drops of hydrochloric acid, dilute and filter off Ir., Rh., Ru. and SiO_2 through a small ashless paper. Weigh as such after ignition.

Evaporate the filtrate and washings, take up in a few drops of hydrochloric acid, dilute slightly and precipitate the platinum with ammonium chloride. Wash the precipitate with cold 20% ammonium chloride, make the filtrate and washings slightly alkaline with sodium carbonate and precipitate any iridium and palladium by boiling with formic acid.

The quantity of these metals obtained at this point is usually very small. They can be separated by treating the precipitate with dilute nitric acid which leaves the iridium insoluble, the palladium being recovered from solution by means of dimethylglyoxime after expulsion of nitric acid by repeated evaporations with hydrochloric acid.

The filtrate from the formic acid precipitate is treated with ammonia and

ammonium sulphide for the precipitation of any base metals present.

The percentage of platinum is then arrived at by deducting the sum of the impurities from 100·000%.

THE ANALYSIS OF PALLADIUM.—Weigh 5 grms. of sample into a 250 cc. squat beaker and add 80 ccs. of water and 20 ccs. of nitric acid, sp.gr. 1·42. Cover and stand on the hot plate just below boiling point for a couple of hours, stirring the pieces occasionally with a glass rod. Decant through a 5½ or 7 cm. No. 40 Whatman filter paper and reserve the paper. Retreat the residue with 40 ccs. of water and 10 ccs. of nitric acid, then filter through the original paper and wash until the washings are colourless.

The Residue.—The residue is ignited, brushed back into the original beaker, moistened with formic acid, sp.gr. 1·20, in order to reduce any palladium oxide, dried and heated at 75–80° C. for a couple of hours or so with 30 ccs. of hydrochloric acid and 10 ccs. of nitric acid. If treatment of the ignited residue, by moistening with formic acid, does not appear to be very effective in reducing the palladium oxide, give a boil up with 20% formic acid, then filter, ignite in a covered crucible, moisten with formic acid, dry and attack with 40 ccs. of aqua regia.

Dilute the aqua regia extract somewhat, filter through a small filter, wash well with hot water, ignite the residue and weigh as Ir., Rh., Ru., and SiO_2.

Evaporate the aqua regia filtrate and washings to dryness without baking, and give three hydrochloric acid evaporations, using 15–20 ccs. each time, taking care to evaporate only just to dryness. Now take up in a few drops of hydrochloric acid and a few ccs. of water, dilute a little with water acidulated with hydrochloric acid (in order to prevent formation of insoluble basic compounds) and precipitate the palladium by the addition of 30–40 ccs. of a 1% solution of dimethylglyoxime in alcohol. Allow to stand on the side of the hot plate for half an hour with occasional stirring. Filter through an ashless paper, wash well with hot water, dry, ignite (cautiously at first, then more strongly) in a covered crucible. Annealing cups answer very well for the ignitions. Moisten the ignited palladium sponge with formic acid, dry and weigh as palladium. Multiply the percentage found by 0·15 to obtain the oxygen equivalent.

The filtrate from the palladium is evaporated until alcohol is no longer smelt, but care should be taken to avoid concentration of the solution, by adding water from time to time in order to keep the bulk up. When alcohol can no longer be smelt, neutralize the solution with sodium carbonate and precipitate the platinum and any iridium, by the addition of 10 ccs. of formic acid, followed by a gentle boil for 1 hour. Reboil the filtrate with more formic acid to ensure complete precipitation of the platinoids. The ignited metals are weighed as Pt. + Ir.

The clear filtrate (X) is made alkaline by the addition of ammonium hydroxide and the base metals precipitated by boiling the solution with 10 ccs. of yellow ammonium sulphide. Allow to settle on the hot plate, preferably over night, filter off, wash with hot water, ignite at a low temperature and weigh as base metal oxides.

The Nitric Acid Extractions.—These are given three repeated evaporations with hydrochloric acid, in order to free from nitric acid, then taken up in a few drops of hydrochloric acid and a few ccs. of water. Dilute with water acidulated with hydrochloric acid, heat to 60° C. and add a large excess of saturated ammonium chloride solution. Cool, and when quite cold, filter off any ammonium platinic chloride, wash with cold 20% ammonium chloride solution, dry and ignite in a covered crucible, very slowly at first, then more strongly, finishing up at about 800° C.

The filtrate and washings are made slightly alkaline with sodium carbonate and the palladium precipitated by boiling for 1 hour with 30 ccs. of formic acid. Treat the filtrate with more formic acid and boiling for a further half hour to ensure freedom from Pd. When a filtrate free from palladium is obtained, neutralize with ammonium hydroxide and boil for 10 minutes with 10 ccs. of yellow ammonium sulphide. If desired, this solution can be combined with the filtrate (X) above, and the two treated together for the base metals precipitation.

The percentage of palladium is then estimated by substracting the sum of the impurities from 100·000%.

It may appear unnecessary to look for platinum in the 1 : 4 nitric acid extractions of the palladium assay. On many occasions I have not found any, but on other occasions I have. It is suggested that where it has been found, the batches from which samples

have been taken, have been heated to a higher temperature than usual in the conversion of compound to metal with consequent formation of a platinum-paladium compound, or alloy, soluble in dilute nitric acid.

It seems very probable that the palladium insoluble in 1 : 4 nitric acid exists as palladium oxide, hence the calculation of the oxygen equivalent.

In the analyses carried out, the Ir.. Rh., Ru. and SiO_2, insolubles were mainly SiO_2, being derived from the silica crucibles used for ignition of the platinum and palladium compounds to metal.

In conclusion, I should like to acknowledge the very helpful advice given me during the development of these procedures, by my friend, Mr. W. T. Phillips. I must also acknowledge my indebtedness to "The Analysis of Minerals and Ores of the Rarer Elements" by Messrs. Schoeller and Powell, for much useful information obtained therefrom.

BOOK REVIEWS

Milling Methods. 1930. Transactions of the American Institute of Mining and Metallurgical Engineers. Cloth, octavo, 554 pages, illustrated. Price 25s. New York: The American Institute of Mining and Metallurgical Engineers.

It is part of the expressed policy of the A.I.M.M.E. to publish from time to time "special volumes whenever sufficient papers accumulate upon a particular subject." This book on milling methods is such a volume. It contains 20 selected papers which have been read at certain meetings of the Institute during 1928, 1929, and 1930. A special committee, known as the Milling Methods Committee of the Institute, consisting in all of 52 members with five chairmen, had charge of the production of the volume.

We are, unhappily, familiar with the uneven quality, repetition, and inaccuracy of some text-books published under the names of many authors, some experts, some dabblers in science, and some apparently journalists. This volume contains none of such faults. Each paper is of a high standard of excellence and written by an authority directly in touch with his subject. The information contained is thoroughly up-to-date and where deductions from practice or experiment are put forward the reader is guided by the clarity, and sometimes startled by the vigour of the discussions, which are also included in the volume. In milling methods American practice seems to have entered on an era of exhaustive and accurate trial and experiment and astonishingly free exchange of information; it is to be hoped that it has left behind for ever the more classical methods of secrecy and "blundering empiricism."

The 20 papers with their discussions occupy over 540 closely printed pages; of these pages grinding and classification take about 150 and flotation about 200. The remainder are occupied with papers on calculations, microscope work, and cyanidation, except for one paper of 60 pages dealing with research on pneumatic table operation, (A. F. Taggart and R. L. L. Oertel.) This latter is the only paper on gravity concentration. The first three papers are by John Gross and S. R. Zimmerley of the Intermountain Experiment Station of the U.S. Bureau of Mines and deal with the surface measurement of quartz particles by the hydrofluoric acid solution method, the relation of measured surface to sieve sizes and the relation of work input to surface product in crushing quartz. The accuracy of the dissolution method is discussed in detail. This accuracy is naturally most important if the method is to be used as a check on screen sizing and hence on the amount of surface produced by crushing. "The lowest and highest values obtained so far for −200 mesh crushed quartz are 2,043 sq. cm. per gramme and 7,055 sq. cm. per gramme respectively" corresponding to an average particle size of 18 and 5 microns (1 micron = 0·001 mm.) respectively. The generally assumed size for −200 mesh material, material passing through a screen with an aperture 65 microns in width, is 37 microns, i.e. the mean between the opening in the 200 mesh sieve and zero, hence the divergence is considerable. A case in which the average size was equal to 2 microns is quoted, i.e. less than the diameter of the particles in tobacco smoke. Perhaps such material is concentrated by "hot air" on the newest type of pneumatic table. It is interesting to note that a figure of 7,055 sq. cm. per gramme corresponds to 8,480,000 sq. ft. per ton, a

large area for a tenth of a pound flotation reagent to tackle. (On the Sullivan Mine the ore is crushed to nearly 90% −200 and is much softer than quartz.) The authors conclude that "when crushing quartz the new surface produced is in direct proportion to the work input in accordance with the Rittinger Law of crushing." A corollary to this is that overgrinding consumes an altogether dis-proportionate amount of power.

The next paper in this section is a laboratory investigation of ball-milling as distinct from tube-milling, and is followed by a paper on classifier efficiency by A. W. Fahrenwald, who uses the word "efficiency" in a somewhat ambiguous manner. The mill-man would prefer to regard the subsequent increase in recovery at a decreased cost as the measure of efficiency of a classifier. Formulae applied to various spigot products without due regard to the proportions by weight of those products, may produce very misleading figures. Moreover, complication, erratic action, and unreliability may also offset even correct test figures. Formulae for the expression of classifier efficiency, like aspidestras, have their admirers, but with most base-metal ores and many gold ores the different specific gravities of the various constituents of the pulp militate against the "efficiency" of such formulae.

The next two papers are on "Differential Grinding as Applied to Tailing Retreatment" by L. M. Banks and G. A. Johnson, and on "Classification in Fine Grinding" by J. V. N. Dorr and A. D. Marriot, which together with their discussion constitute an extremely interesting and helpful contribution to a subject which in view of the requirements of flotation has acquired considerable importance.

The first paper in the section on flotation is a masterly thesis with a wealth of experiment and bibliography contributed by A. F. Taggart, T. C. Taylor, and A. F. Knoll on "Chemical Reactions in Flotation." This paper deals with the proposition that "in flotation with soluble reagents all phenomena governing collection are controlled through simple chemical reactions between the reagent and compounds occurring at the surfaces of the particles affected." The dogmatism (p. 217) of this paper is a virtue in that it stimulates careful and reasoned discussion both in America and elsewhere. The bold exposition of positive views promotes advances, the careful student and the trained scientist generally merely consolidate the ground behind when the advance has been carried too far.

Another contribution on flotation "Experiments with Flotation Reagents" is also written under the auspices of Prof. Taggart and Prof. Taylor, but is a condensed account of experimental results obtained in the ore-dressing laboratory of the Columbia School of Mines. Quantitative figures as to frothing and collecting properties of about 500 different compounds in acid, neutral, and alkaline pulps are recorded. If only this fundamental work had been done much earlier many patent fees would have been lost and progress would have been far more rapid.

Three of the remaining five papers on flotation deal with the activation of sphalerite. That by O. C. Ralston and others of the United Verde Copper Co. (who also have a paper on lime consumption) is particularly noteworthy as an example of application of laboratory research work to a practical milling problem. The paper itself is a model of concise but adequate exposition. Prof. A. M. Gaudin with his familiar mastery of chemistry and physics deals with the same subject but as a "flotation fundamental" and shows that "sphalerite readily acquires from copper-bearing solutions a coating of covellite having a thickness of a few atomic diameters" and that on the employment of this property rests, fundamentally, the activation of sphalerite.

The use of graphs and formulae to express the degree of beneficiation accomplished in an ore-dressing operation is discussed thoroughly in two papers, one from the Kaiser Wilhelm Institut für Eisenforschung and the other from the Montana School of Mines. In the latter paper Prof. Gaudin recommends the geometrical average as preventing undue weight being placed on a single ratio, but does not support his preference for the geometric mean by an appeal to fundamentals as Prof. Truscott did, in another connexion, before the Institution of Mining and Metallurgy in October last.

The last two papers in this volume deal respectively with cyanide generation or recovery (G. W. Law) and with the effect of copper and zinc in cyanidation (E. S. Leaver and J. A. Woolf). The former paper reviews the practice costs and profits of cyanide regeneration and includes an excellent bibliography on the subject. The latter paper deals with promising laboratory results

obtained on the cyanidation of a gold-silver ore containing cyanide-soluble copper and with the effect of zinc in cyanide solutions. The regeneration of cyanide solutions is dealt with in this paper in connexion with the removal of copper from solution and the dissolving efficiency of regenerated solutions is discussed. It is found that the ratio of pounds of cyanide used to pounds of copper dissolved varies from 1·85 to 2·75 for different minerals and that the percentage of cyanide effectively regenerated by the sodium sulphide-sulphuric acid method averages about 80%. It is predicted that in most cases the cost of chemicals will only slightly exceed the selling price of the copper recovered, that is, presumably, if they both fall in price together.

B. W. Holman.

The Principles of Coal Property Valuation. By A. W. Hesse. Limp cloth, octavo, 183 pages, illustrated. Price 15s. London: Chapman and Hall.

This little book is divided into three parts or chapters. Part 1 is devoted to the valuation of virgin coal lands. Therein the author exemplifies the importance of studying geological and topographical features, accessibility, boring information, the estimation of assured, probable, and possible coal, the methods of sampling and the value of chemical analysis, and, finally, the necessity of carefully examining mining leases.

Part 2 is confined to the valuation of operating mines, attention being given to the following: Estimate of plant and equipment; classification of equipment; depreciation; history of property; railroads; water supply; coal cleaning; cost of production, and estimate of profit; labour; power supply, etc. The author gives a figure of $1 per ton of annual output as the approximate cost of plant, equipment, and shafts of a United States colliery in the year 1914. Even allowing for the additional cost of labour and equipment since the war, this estimate is much below that for a modern British colliery, the difference being due no doubt to our very high sinking costs. The eleven pages of depreciation rates for all kinds of mining plant and equipment form a valuable section of the book. The part dealing with railroads is not applicable to mining valuation in this country. The author deals much too fully in a book of this nature with coal cleaning. He suggests a range of gravities of from 1·3 to 2·00 for coal cleaning tests, whereas in this country gravities of 1·25 to 1·75 are found sufficient.

Part 3 deals with appraisals and valuations. The theoretical aspects of valuation are herein discussed and specimen sheets are shown for collecting data. Several valuation tables are given and finally logarithms of numbers 1 to 1,000.

The book contains many Americanisms, such as, for example, "To get a fairly accurate line on the assured coal," but it can be read by mining students in this country with profit.

K. Neville Moss.

Geologische Karte der Erde. Lieferung 2. Blätter 5, 6, 9 and 10. Scale $\frac{1}{15,000,000}$ (1 inch=236·7 miles). Subscription price for the complete map, 150 marks. Berlin: Gebrüder Borntraeger, 1930.

The first part of Beyschlag's geological map of the world was reviewed in the June number, 1930, p. 355, of this Magazine. The second part, now issued, completes the American hemisphere and includes the southern United States, Central and South America, New Zealand, the Pacific Islands and part of Antarctica. The remaining part, in course of publication, will complete the map with Africa, India, and Australia and the rest of Antarctica. A colour legend will accompany the final delivery, but meanwhile the map cannot be easily read. In South America for example two differently coloured patches are both marked Pk, a symbol which does not appear in the preliminary explanation already provided. Where the geology is still incompletely known the map necessarily gives an impression of certainty which may be far from justified. Comparison with du Toit's 1927 map of part of South America, for example, reveals many differences. A booklet embodying the chief sources of information would be helpful in drawing attention to such unavoidable limitations and discrepancies. There is a curious mistake in Antarctica where King Edward VII Land is called "König Edward II land." The layer tints and registration of colours and overshading are excellent, and their choice brings out the broader structural features very clearly.

A Guide to Mining in Rhodesia. By F. P. Mennell. Paper backs, 160 pages, illustrated. Price 5s. 6d. Bulawayo: Rhodesia Printing and Publishing Co., Ltd.

As stated in the preface this is in reality "The Rhodesian Miners' Handbook" of 1908 by the same author, brought up to date. The present title of the book is, however, misleading for the contents of the volume deal equally with the mines and ore-deposits of Southern and of Northern Rhodesia, which politically, and one might add, in almost every other respect also, are two entirely distinct countries, however much Southern Rhodesia may long for political unity.

It is a pity that the general "get-up" of the volume is not up to that of the original, for while the former was excellent—the latter, especially in the illustrations, is so inferior that many people who have not read it may be discouraged from obtaining possession of it. This is, however, the only adverse criticism which can be made of the book, which, as was the original, is well written, comprehensive and yet concise and interesting.

In the Rhodesias practically the whole European population is keenly interested, either at times or permanently, in mining adventures and wants to understand them, yet but few members of that population have had any scientific education. Even amongst those constantly engaging in mining ventures, or in the mining industry, there is no general standard of knowledge of the subject to be written up to, or down to. Perhaps twenty per cent. of those into whose hands this book will come may have studied geology, but the vast majority, even if they have had a life-long experience of mining and prospecting, are quite at sea when enveloped in a geological treatise bristling with modern nomenclature. Under these circumstances the author is to be congratulated on having steered a very sound course. He has managed to convey all the geological and scientific knowledge at his disposal in plain English without one word of "geological-polylingual jargon" and with as few technical words as cannot be avoided.

The eight chapters of the book cover the the whole subject—History—Geology—Ore Deposits—Opportunities for Small Workers—Laws, etc., ending with a chapter on each of the mineral products and the mines producing it. At the end of every chapter a list of "Principal References" to much of the available literature on the subject is given. This alone renders the volume a real guide to those who wish for detailed information on any one of the subjects dealt with. Though the book is written for Rhodesians by a Rhodesian it is certainly worth being read and kept as a work of reference by the multitude of people all over the world who are directly or indirectly interested in Rhodesia or in the mineral resources of the world.

Tudor G. Trevor.

Petroleum in Roumania: A General Review of the Economic, Statistical and Juridicial Situation. By Mihail Pizanty. Paper covers, 100 pages. Illustrated. Price $2. Bucharest: *Moniteur du Pétrol Roumain.*

The chief value of this pamphlet is that it gives an excellent summary of the present economics of the Roumanian oil industry and contains a great deal of information not easily accessible to English-speaking students. It is not to be taken as a technical dissertation, but rather as a digest of that sort of weighty statistical matter common to "white papers" and "blue books" concerned with kindred activities in this country. The contents include a review of the current mining laws, stabilized in 1924, drilling and exploitation, a discussion of natural gas, petroleum refining, statistics of the personnel engaged in the oil industry, a section on the home consumption of oil products, accounts of the transport and storage of oil, exports, finance, market prices and tariffs.

The pamphlet is in English and is very readable. There are several illustrations, on the whole of poor quality, a useful general plan of certain important oilfields (Moreni, Gorgota, Gura Ocnitei, etc.), a State and private pipe-line plan, and a map of the country showing the principal fields and their relative production in 1929. There are a number of diagrams and much tabular matter scattered through the text. There is no index, a decided flaw in the plan of a book of 100 pages of detail, and the contents page instead of being in front is found sandwiched in the text on page 95, the remaining pages to the end being devoted to what appears to be an afterthought—the situation in 1930, presumably only for the first quarter of the year. At the price of two dollars

(American) this seems a somewhat expensive publication and the intending purchaser might be put off by the lack of more substantial covers, to say nothing of the rather cheap appearance of the book as a whole. However, the substance is good and bears eloquent testimony to the fundamental importance to Europe in general and to Roumania in particular of a great and progressive industry.

H. B. MILNER.

The Modern Dowser. A Guide to the Use of the Divining Rod and Pendulum.—By LE VICOMTE HENRY DE FRANCE. Price 3s. 6d. London: G. Bell & Sons, Ltd.

The divining rod, its uses and abuses, have interested mankind, especially the miner, for an unknown number of centuries. Perhaps the earliest book illustration of dowsers at work with their Y-shaped flexible rods of hazel about 2 ft. in length, is that in Agricola's "De Re Metallica," 1556, reproduced in Brough's well-known text-book on "Mine Surveying," and again in the Hoovers' translation of "De Re Metallica" in 1912.

The rods of the most ancient records were not bifurcated, as for example those applied to enchantments, to sorcery, or to such misuses of the magic wand, as apart from such commendable purposes as instanced by Moses and Aaron in the disillusionment of Pharaoh, or in obtaining a water supply in Horeb.

Luther condemned dowsing in 1518. Agricola was evidently a doubter, and the translators of his book were unbelievers, but Pryce expressed his unmistakable belief in the art of dowsing in his "Mineralogia Cornubiensis," published in 1778 though written several years earlier. He quoted extensively from the "accurate observations on the virtues of the Virgula Divinatoria," with which he had been favoured by his "worthy friend" William Cookworthy, of Plymouth, whose improvements in the manufacture of porcelain marked an important change in the application of china clay to the arts and manufactures.

In the numerous controversies of the past on the subject of dowsing, supporters usually regarded the ability to use the rod as a special gift confined to the few, and not to be acquired by the multitude. The author of the "Modern Dowser" claims that the art can be acquired like any other art, though a certain predisposition on the part of the learner is desirable, as in the case of music; also that dowsing is subject to certain recognized laws, a knowledge of which assists the would-be learner.

The dowser's essential—and strikingly simple—instruments are the rod and the pendulum. The former may be of wood, not necessarily hazel, or of steel-wire, whalebone, etc., whalebone being preferable, 8 or 10 in. long and $\frac{1}{4}$ to $\frac{3}{8}$ in. wide, the two pieces tied together at one end in such a way that when the other ends are parted, the apparatus assumes the shape of the letter V. "Actually this rod is a spring." The pendulum may be a cylinder, or a ball, of wood, glass, lead or even quartz, choice being given to a wooden sphere or cylinder of 1·4 oz. weight.

The causes of the movements, oscillation and gyration, are discussed in chap. ii, followed by "a practical method of learning by means of electric currents" in chap. iii. The locating of water is dealt with in chap. iv; and chap. v treats of rocks, ores, minerals and metals. Later chapters relate to vegetable investigation and to biology and medicine.

The little treatise describes a series of experiments which an impartial reader will find interesting, as also are the conclusions which are drawn for his special consideration. He will certainly be tempted to try some of the experiments, and will be assisted to this end by the thirteen excellent illustrations which are described in the text.

While recalling the facts that the origin of the rod is lost in the mists of time, and that its use has been always surrounded by an atmosphere of mystery, the author concludes that there is nothing supernormal in the movements of the rod and pendulum, which can be explained by well-known laws of electric and electromagnetic waves. He claims that great progress has recently been made, a thorough knowledge of geology in its various branches having largely contributed to progress. Early in 1930 a course of instruction in dowsing—the first ever held—was established at Abbeville.

Records and general experiences are practically confined to France. An extension to include an outline of dowsing in other countries would add to the attractions of the book, although in its absence the author provides extremely

attractive reading which should specially appeal to prospectors at work in isolated regions and tempt them to try some of the experiments detailed.

WILLIAM THOMAS.

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

LETTERS TO THE EDITOR

The Education of the Engineer

SIR,—For some months letters have appeared in the public press about the education of mining engineers in England. In your October issue you publish one from Mr. G. C. Barnard, who writes from Northern Rhodesia, advocating the fusion of the Royal School of Mines in London with the School of Metalliferous Mining at Camborne, Cornwall.

At the time I retired from the professorship of mining at the Royal School of Mines in 1919 I was interesting myself in furthering proposals for joining the Royal School of Mines and the Camborne School. Briefly, the idea was that the first, second, and fourth years' work should be taken in London and the third year's course, devoted to mining (Part I), mine surveying, and economic geology, in Cornwall. These proposals, however, were not favourably received and were allowed to drop.

It appears to me that just as it is found advantageous to have schools for sailors near the sea so it would prove a sound idea for students of mining engineering to be in as close touch as practicable with the actual work and atmosphere of mining.

WM. FRECHEVILLE.

114, Queen's Gate, S.W. 7.
October 28.

SIR,—Mr. G. C. Barnard, in his letter in your last issue, appears to be under a misapprehension regarding the curriculum at the Royal School of Mines. He states: "It would appear advisable, after the first year's general course, that a student should be able to specialize if he so wishes." A student at the R.S.M. takes a four years' course leading to Associateship in either mining, mining geology, metallurgy, or oil technology, these courses all being distinct and different after the first year and a half or two years.

Mr. Barnard also states: "It may be said that the course at the R.S.M. is too theoretical" and that it would be better if "the practical side of such subjects as mining, geology, surveying, milling, etc.," could be taken in Cornwall. I would point out that the R.S.M. surveying course takes place at Tywarnhaile Mine, near Redruth, and is a very full and practical one. I think I am also right in saying that the mill plant at the R.S.M. is as large and as up to date as that at any college or school of mines in Great Britain. One of the conditions of the Associateship of the Royal School of Mines (in mining) is that the student must have completed not less than 720 hours' practical work underground. This is done in vacations, on producing mines. The teaching staff at the R.S.M. is second to none, each being a specialist in his own subject, and students also have the opportunity of studying electrical engineering at the City and Guilds College and pure science subjects at the Royal College of Science. Under these circumstances I cannot see what is to be gained by amalgamation with the Camborne School of Mines, as suggested by Mr. Barnard.

As regards the criticism that the training at the R.S.M. is too theoretical, it is very probable that the only time in his life that a mining engineer will have the opportunity of theoretical training is when he is at college, while practical experience can be gained afterwards; surely, then, it is better to devote the majority of his time while at college to theoretical work.

J. DOUGLAS DIXON.

Sutton, Surrey.
October 18.

NEWS LETTERS

JOHANNESBURG

October 9.

Low-Grade Ore Commission.—At the time of writing the Low-Grade Ore Commission had held two public sittings and heard two very important witnesses. At the first sitting Dr. Hans Pirow, the Government Mining Engineer, submitted a scheme whereby the working costs of the Witwatersrand gold mining industry might so far be reduced as to make large quantities of low-grade ore, at present unattractive, workable at a profit. The scheme includes the removal of the largest possible number of white

miners from underground to surface employment without reduction in their numbers or of the ratio between white and black. The chief savings, Dr. Pirow considers, would be effected in respect of phthisis and accident compensation. The scheme provides for Government supervision of the ore-reserve calculations of any mine, and an undertaking from each mine that only ore of an agreed grade will be exploited. Dr. Pirow explained that the proposals only represented his personal opinions, and should not be regarded as reflecting the attitude of the Mines Department. "I am unable to present to the Commission a fully worked-out scheme," he said, "nor is it possible to work out a scheme of this nature unaided. It will be necessary to consult a number of bodies likely to be affected by such a scheme and to obtain technical opinion on it from various sources." On the other hand he felt that the submission of the proposals would result in investigations that might point a way to success, even if his proposals were not acceptable. Dr. Pirow's proposal is not an entirely new one. A similar suggestion was made by Mr. O. Pirow, the Acting Minister of Mines, in the course of a speech on the West Rand. The matter originated with members of the Labour Party some months ago. It is believed that the proposal will receive considerable backing, both in the Cabinet and in the House of Assembly, and that the Nationalist leaders of the miners have already been consulted on the matter, and are prepared to give it their fullest support. Before long it will become a political plank of the National Party in the Transvaal, and that party, which is very anxious to secure the undivided allegiance of the mine-workers on the Witwatersrand, has hailed it with delight.

Reduction of Miners' Wages Advocated.—Dr. P. M. Anderson, the President of the Chamber of Mines, was the other important witness. In the course of a memorandum he dealt at length with the position of the gold mining industry, and emphasized that the problem of the working of low-grade ore was not one which affected the "low grade" mines only; every mine possessed quantities of low-grade ore which could not be worked unless the cost of working was covered by the yield of gold won. Any action which increased the cost of working automatically threw out of production in every mine ore that would otherwise be mined, just as decreases in working costs brought into the region of payability ore that would otherwise be left untouched. Dr. Anderson said the Gold Producers' Committee felt that, as the cost of living conditions had improved since the inquiry of the Mining Industry Arbitration Board (Lucas award), 1926–27, to the benefit of employees, a reduction of 5% in wages should now take place. Such a reduction in the salaries and wages paid to the European employees by the gold mines would mean a direct reduction of £400,000 a year in working costs. "A downward trend in the wage level on the Witwatersrand gold mines," Dr. Anderson added, "would undoubtedly influence wages in other parts of the country in a similar direction, more especially as the decrease in the cost of living is not confined to the Witwatersrand, but is fairly general throughout the Union. A reduction in the level of wages in South Africa would be followed by a decrease in the price of South African products, with great benefit to South African producers generally, while the mines would reap an advantage, both directly and indirectly, in reduced costs through a reduction in wage levels."

Another Diamond Discovery.—Some men in possession of base-metal prospecting licences who have recently been carrying on operations in the Kamaggas Native Reserve in Namaqualand have discovered diamonds in the reserve and indications of the existence of an important diamond field there have been disclosed. It is stated that applications for discoverer's rights have been refused and that all prospecting operations in the reserve have been stopped by order of the Government. This discovery appears to upset the theories of the geologists who have been in Namaqualand as to the origin of the Kleinze and other diamonds on the Namaqualand coast. The site of the discovery is approximately 35 miles from the coast and Kleinze, and this spot, as does Kleinze, lies on the banks of the Buffels River.

A Manganese Deal.—Negotiations for the sale and marketing of South African Manganese Company's output to the Manganese Corporation are now practically completed and the terms will be announced in due course. Recently the directors of the South African Manganese Co. inspected the company's workings at Postmasburg in company with the directors and engineers of the Manganese Corporation, and it is understood that the latter expressed them-

selves as fully satisfied with the quality of the ore exposed and the indications of very substantial tonnages in the areas now being developed.

Bird Reef Possibilities.—Prospecting operations on the gold-bearing reefs that lie above or below the recognized horizon of the Rand Main Reef Series have shown that these little-known bodies are not to be entirely disregarded as potential factors in the future production of this great gold field. Two West Rand mines are now opening up the Bird Reef with success and crushing substantial tonnages. The results obtained at the Consolidated Main Reef Mines and Estate, Ltd., actually go to show that the pay reef of these reefs may yet materially prolong the lives of other mines, and possibly make available extensive outcrop areas extending over many miles of country. During the early part of 1926 the management of this mine sampled some old workings on this reef and, owing to the encouraging values obtained on the western section, development work was commenced which also gave pay values, thus justifying a development scheme being drawn up and work being tackled in earnest. The reef, which is approximately 3,000 ft. to the south of the main reef series, strikes east and west and traverses the entire property. Reference to the annual report of the company for the year ending June 30, 1927, shows that 2,075 ft. were sampled, of which 1,115 ft. were payable and gave a value of 5·9 dwts. over an average width of 51 in. By June 30, 1929, the possibility of this reef had been definitely proved and an ore reserve of 287,210 tons of an average value of 5·0 dwts. over 64·4 in. had been blocked out. It is anticipated that the Bird Reef will be called upon to replace the loss of tonnage due to the falling off in value of the main reef leader, and for this reason development is being pushed ahead with all speed. The claim area in which the Bird Reef occurs is considerable, and when one takes into consideration the width of 64·4 in., and the shallow depth at which it is available it will be readily seen that working costs should be extremely low and allow of a good profit on a 5 dwts. basis. Another company which is giving its attention to the mining of this reef is the Randfontein Estates, which has reopened sections of what is known locally as the East Reefs. The deposits here contain several payable reefs from which considerable tonnages have been mined in the past, resulting in a huge open working which is unique for open-cast workings on the Rand. The reefs are situated about 1,700 ft. to the east of the Main or Botha's Reef series, and strike more or less north and south through the property for approximately seven miles. The main or No. 14 shaft on this reef supplies approximately 25,000 tons of reef a year to the mill, and although the value of the ore is low here, the big widths and shallow depths allow of cheap mining. An area on which a large amount of development was done in the past was the French Rand mine, through whose property the Bird Reef outcrops. Numerous shafts and winzes were put down, and on the central portion a certain amount of stoping was done with good results, although the high working costs prevailing on that property during those times made profits impossible.

An American Syndicate's Venture.—According to a Rhodesian journal, the option secured two years ago by Mr. Raymond Brooks on the Kasonso copper proposition in Northern Rhodesia has been exercised by the syndicate, representing powerful American interests, formed by Mr. Brooks. The terms of purchase have not yet been made public but it is understood that the vendors have good reason to be satisfied with the deal. During the period of option extensive drilling has been carried out, and the fact of the option having been exercised is sufficient testimony to the prospects of the mine, both in regard to ore tonnage and values. A scheme of development has been planned and is to be commenced forthwith, including the sinking of several permanent shafts. About half a mile from the Kasonso Mine is a parallel ore-body known as the "Torka," and this body is also to be drilled as soon as arrangements can be made for a water supply.

Rhodesia's New Coalfield.—On one of the prospecting areas in the Hot Springs coalfield, in Northern Rhodesia, bore-holes have penetrated three distinct coal seams, the widths respectively being 7 ft. 8 in., 5 ft. 4 in., and 7 ft. Depreciatory rumours have been current in regard to the calorific value of the Hot Springs coal measures, but these have been countered by statements of a directly opposite nature. However this may be, taking into consideration the close proximity of the new coalfield to the great copper belts of Northern Rhodesia, it seems likely that it will become a complementary and important economic factor in the

exploitation of the copper mines now hastening towards production. The use of pulverized coal is being generally adopted in the North, and costly pulverization plants are already nearing completion. The powdered coal will be delivered direct to the boilers by pneumatic pressure over distances of several hundred yards. Companies holding areas in the new field include the Tanganyika Concessions, Ltd., Loangwa Concessions, and the Wankie Colliery Company.

BRISBANE

September 17.

Progress at Mount Isa.—Mr. C. A. Mitke, a member of the technical committee of the Mining Trust, Ltd., has been at Mount Isa for some time, and is expected to remain there until milling begins. According to the latest report from the local mining warden, the completion of all operations preparatory to crushing is in sight. The Davidson shaft, on the Black Star lode, has been connected, by means of the main haulage level, with the supply shaft at a depth of 350 ft. As that level has been graded downwards from the Black Star ore-bodies, the pumps at the Davidson have been withdrawn, and are being used in strengthening the attack on the large influx of water that has occurred at the supply shaft. It is expected that the whole of this level, from the Davidson and the Urquhart (main haulage) shafts, will be finished about the middle of November. The water in the level will then drain to a sump in the Urquhart shaft, where it will first be filtered and then pumped to the surface. The pumps for this work will be capable of dealing with 4,000 gallons of water per minute. The branch haulage level from the Lawlor shaft (Rio Grande lode) to the Doherty shaft, on the Black Rock lode, a distance of about 200 ft., will not be started until the latter shaft has been connected with the main haulage level, and will therefore not be available for the transport of ore underground until some months after the beginning of crushing. Until it is available, however, the ore from the Lawlor will be taken to the surface and carted by rail to a glory-hole on the Black Star lode. There it will be dropped into the main haulage level, and thence carried underground to the Urquhart shaft. While the ore pockets at the bottom of the Urquhart shaft, designed to allow of the automatic hoisting of the ore, will not be ready till the end of December, it is anticipated that by the close of November the mill will begin crushing, at the rate of 600 tons a day, ore placed in the skips by hand. Immediately after Christmas the automatic hoisting of ore should begin, and the treatment commenced of the 2,000 tons of ore which is to be the full initial output. During next year the carbonate ore from the three developed ore-bodies will form the main bulk of the material to be treated. With the lower grade ore from the Black Star lode will be mixed those of a richer grade from the Black Rock and Rio Grande lodes. It is estimated that the 2,000 tons to be put through the mill daily will produce about 200 tons of lead bullion.

North Queensland Mining.—Despite the low prices ruling for metals, only a few mines are being abandoned in the premier Queensland tinfield of Herberton and in the adjoining Chillagoe mineral district. In some cases the owners continue to raise ore and stack it until the market improves. In others, where finances are more restricted, it is considered better to realize on the output for a small reward rather than have the mines closed down and the miners idle. These latter are greatly assisted by the Chillagoe State smelters, which are fortunately being kept in commission, albeit at a loss. This loss, however, is very much smaller than that incurred when the smelters were formerly in operation, and is considered to be justifiable in view of the help afforded to the working miner. In the Herberton field there are several new tin-dredging enterprises, which seem to be gradually " getting on their feet " and which, if successful, should in the future add considerably to the mineral yield of the district. Since the re-opening of the smelters last year till the end of June, 1930, the value of the copper, silver, and gold yielded by ore treated amounted to nearly £60,500.

To Assist Mining.—To assist mining, as well as the pastoral industry, in the present period of depression, the Queensland Government has decided to exempt from the operations of the Industrial Conciliation and Arbitration Court, gold and metalliferous mining other than that of silver and lead, and the pastoral industry. This means that employers in those industries will be at liberty to pay—and employees to accept if they think fit—rates of wages lower than

those fixed by existing awards. The Mount Isa mines, which will be producers of silver and lead, will continue to be operated under the Act, but steps have already been taken before the Arbitration Court to reduce the rates of pay provided for by awards.

Oil Prospecting.—Efforts to find oil in Queensland, although considerably lessened in the past few months, are still being prosecuted by eight or nine companies putting down eleven bores. The chief centre of activity has been shifted from what is known as Hospital Hill, at Roma, to Blythdale, a railway station on the Western Railway 11 miles east of that township and 300 miles west of Brisbane. Hitherto nearly all the bores sunk in this (the Maranoa) district outside Roma have been north-west of Roma, extending nearly 50 miles in that direction. At Blythdale there are now being sunk five wells, including one by the Roma Oil Corporation, which has meanwhile stopped work at Roma, where it put down three bores and installed a small oil absorption plant to recover oil from gas escaping from the company's No. 3 well. Of four bores being drilled at Blythdale by the Australian Roma Oil Company, two have encountered oil sands. In the second, at a depth of 3,834 ft., these sands were good, and oil fluid came up in greater quantity, it is said, than any previously reported from Roma. Official tests are now being made in the bore. In Victoria, at Lakes Entrance, Gippsland, crude oil was discovered some time ago. Now it is reported from Melbourne that three wells at that place will be producing oil within a week. The owners of the chief wells—an Adelaide Company, called South Australian Oil, Ltd.—have reported recoveries of 450 gallons of crude oil from its No. 4 well in two days; while the well of the Tanjil Oil Company is said to have been producing oil at the rate of 20 gallons daily.

New Guinea Gold Find.—News of the discovery of a rich gold field in Central New Guinea has been received in Brisbane. It was made, after months of arduous search, by a representative of the Central New Guinea Exploration Company, Ltd.—Mr. E. J. Ubank, an experienced gold miner and prospector—who pegged a gold-mining lease on Edie Creek in 1927. No details of the extent or value of the find are yet available, but the Exploration Company have taken up a large area at the new find.

Pulverized Coal.—Queensland, like New South Wales, has extensive and valuable coal measures, but cannot find enough customers for even the small quantity of coal that is produced. Mainly for this reason, more than usual interest has been taken in the arrival in Brisbane of the German steamer *Stussfort*, the first vessel to reach Australia equipped to burn pulverized coal as fuel. It is expected that the trip of this steamer, which is of 7,395 tons burden, will save her owners about £1,200 each way. Should other steamers adopt this method of fuelling, it is anticipated that trade on the New South Wales coal fields will benefit considerably, as Maitland coal is specially adaptable to pulverizing.

IPOH

October 8.

Price of Tin and Unemployment.—While the price of tin continues to follow the downward curve of depression and the other chief industry of British Malaya is in what certain pessimists regard as a permanently deflated condition there are reasons enough for very serious concern as to the immediate future in this country. Under such circumstances it might be expected that a proportion of the normal labour force would be thrown out of work, but this has not yet happened to any large numbers of employees, and even now a very modest improvement in the price of the metal would go far to stabilize conditions and to demonstrate that the mining industry is not disorganized.

Tin Statistics.—Published statistics record that at the end of September visible supplies had decreased by 3,300 tons and Straits shipments for the month were less by 2,556 tons, amounting to only about half the previous month's total. The normally important total output from China is now greatly decreased by the prevailing anarchy in that country, and with other sources of tin ore in difficulties, through expensive local conditions, it seems certain there must be a great decline in the total production from all these sources together. Continuance of a reasonably sufficient measure of restriction by the remaining chief producers must soon result in accumulated stocks being disposed of. Reliable statistics are most desirable, but in some respects difficult to get.

Malayan Situation.—The present situation in Malaya is abnormal in many respects. Immigration is strictly limited from China, recruitment of labour stopped from India, and many of the unfit are being repatriated to both countries. China, in chaos, is unable to purchase normal requirements of rice from Siam which is an exporting country. Siamese rice therefore becomes available for disposal in Malaya where the supply is generally quite inadequate except very locally in certain districts. The state of China as a market, and industrially, may be suggested by the recent estimate, officially quoted, of 30,000 people perishing there daily from starvation. The effect of the slump on the revenue of the F.M. States is described by the Chief Secretary as that of a veritable landslide necessitating a complete review of the financial position. Compared with the original estimates for 1930 it is anticipated that by the end of the current year the revenue from tin will be short by $5,762,000; rubber by $5,335,000, and other sources of revenue dependent on the spending power of the population will be seriously decreased.

Tin and rubber represent in value about 88% of the total exports under the F.M.S. administration, and other exports having also declined in value a very serious fall in revenue has already resulted. To assist in making up for this loss of revenue certain new duties including one of 5 cents per gallon on liquid fuel were notified under the Customs Enactment. In the Federal Council meetings, held this week in Kuala Lumpur, strong representations were made by Unofficial members as to the unsuitability of imposing fresh burdens upon the mining industry at such a time as the present, and after consideration in Committee the proposed new duties on fuel and lubricating oils have been cancelled.

Perak River Power.—The Perak River Hydro-Electric Power Co. has already had a large and increasing demand for current. A proportion of Chinese consumers failed at first to realize the full advantages and economies made possible by the use of this power supply; but senior engineers of the Company have met their consumers' difficulties in a most helpful manner, going out of their way to advise and instruct. The Power Co. are now offering a demonstration of how things should be done by putting in and running the electrical equipment on a typical open-cast mine near Tronoh, inviting all who are interested to observe the methods and results. One point made is the importance of ample illumination in night work. As heavy storms in the rainy seasons often occur after dusk the advantage of being able to see what is happening are easily realized by any one who has experienced night storms in open-cast mines.

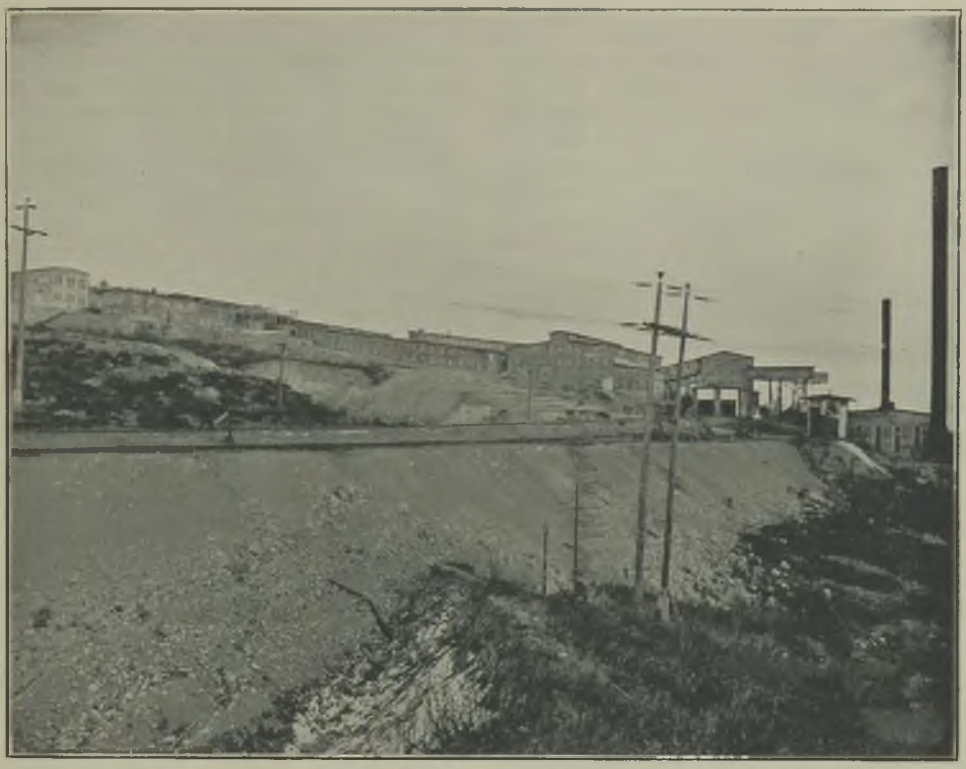
VANCOUVER

October 9.

New Discoveries.—Prospecting during the past summer has brought to light at least two new discoveries that give promise of being of more than ordinary importance. A few miles east of Nahwitti Lake, which is about 17 miles north of Port Hardy, north Vancouver Island, prospectors have found a new silver-lead-zinc district. The ore occurs as bands of high- and low-grade material in a series of zones, 13 of which already have been found, in a deposit of limestone about 2½ miles in width and of as yet undetermined length. The individual zones are of considerable width and samples taken across some of them indicate the whole to be composed of a good grade of mill feed. The limestone is bounded on both sides of its strike by igneous rocks. The discovery was examined by Mr. Harry Lee, a field engineer for Federal Mining and Smelting Company, a subsidiary of American Smelting and Refining Company, who promptly bonded it for his principals and staked adjoining claims, making a consolidation of 25 claims. Mr. Lee took Mr. L. A. Lavenslaver, chief executive for the American Smelting and Refining Company in north-western America, to the property, and, as a result, an intensive campaign of exploration has been started. Supplies are being shipped to Port Hardy whence they are being transferred to Nahwitti Lake by a hydroplane. In the meantime a trail is being made from the lake to the property. The possible fly in the otherwise clear amber is the erratic record of northern Vancouver Island. It has produced several very promising prospects the bottoms of which have been knocked out by development, the most striking example being the discovery of copper ore near Nimpkish Lake, which by many engineers was considered to be the outstanding discovery of last year. On the other hand, the Coast Copper Company's Old Sport mine has now been developed to a depth of 1,400 ft., and a reserve of ore has been blocked out that is expected to pay the

Consolidated Mining and Smelting Company well. Less is known about the other discovery, which is situated to the south-east of Fort Nelson, in the Peace River region. It has been bonded by Mr. Hindmann, a United States contractor, who met the discoverer at Saskatoon, on his way out of the region. An engineer and men have been sent in by airplane and arrangements have been made with Western Canada Airways for bringing out 100 tons of the ore.

it range from 262 to 987 oz. of silver per ton. The remainder of the vein is a good milling grade. Premier Gold Mining Company has paid the usual dividend of 6%, covering operations for the third quarter of this year. The company has closed operations at the Silverado group, the deep development of which has been disappointing. Work at the company's other three properties in the district, Premier, Prosperity, and Porter-Idaho mines, is proceeding satisfactorily.



Sullivan Concentrator, Kimberley, B.C.

Portland Canal.—Snow is appearing on the hills above 2,000 ft. elevation and seasonal development is rapidly drawing to a close. Already several companies have suspended operations for the season. The most important new development so far reported appears to be on the Kenneth group, formerly known as the Mobile group, at Glacier Creek, where by a new tunnel 180 ft. higher up the mountain the Argentine Syndicate has found the upward extension of a rich shoot that was worked by a previous owner 10 years ago. The ore occupies the full face of the drive and assays of 14 in. of

The Premier company's engineers have examined several other properties, including the Terminus, A. and T., and Ruby Silver groups, in the Bear River section, but appear not to have found them sufficiently interesting at the terms asked. B.C. Silver Mines has made application for permission to develop the water rights of Camp Creek, a tributary of Cascade Creek. Operations at the mine are proceeding normally with a small crew.

The Kootenays.—Relief-Arlington Mines, formerly called Second Relief Mining Company, has been reconstructed and has

resumed the development of the Second Relief mine, at Erie Creek, in the Salmon district; increased the capacity of the mill to 75 tons daily by the addition of a 50-ton Hardinge mill and flotation cells; and has added an 80 h.p. Fairbanks-Morse Diesel-type engine. The tunnel has been cleaned out and a strong shoot of ore, averaging $12 to $15 in gold per ton, is being mined on No. 4 level. A first shipment of concentrate has been sent to Tadanac. The company has acquired the old Arlington mine, in the same district, but at present is confining its attention to the Second Relief. West Kootenay Power and Light Company has nearly completed its survey of the Pend d'Oreille River and has practically determined to develop it by one immense dam, which will have a maximum height of nearly 400 ft. at a point near to where the river emerges into the Columbia River. It will ask permission from the Provincial Water Board to proceed with construction in the near future, so that advantage may be taken of low-water period during the coming winter to get work well advanced. It is understood that Reeves-McDonald Mines, which has opposed systematically every application made by the power company, will not oppose this application, but will seek permission to develop a power plant of its own on the Salmon River.

Central District.—Premier Gold Mining Company has acquired a 52% interest in Planet Mining and Reduction Company for $100,000 cash, and has undertaken to form a new company with a capitalization of 5,000,000 shares of no par value, 48% of which are to be allotted to the Planet Company, in consideration for all its assets, and 52% to the Premier Company, which has undertaken to provide funds to develop and equip the property, such funds to be returned out of the profit of operation. Planet owned a large consolidation of claims, including the old Star, Donohue, and Enterprise mines, on Mineral Hill, near Stump Lake, in the Nicola mining division. The company has developed the property by an adit, giving about 350 ft. depth on the vein, instead of by a series of shallow shafts, and proposed to develop the other veins from this adit. It has erected a flotation mill of 125 tons capacity and a 250 h.p. Petter engine. The mill was put into operation at the end of last year and to the end of last July had produced 2,260 oz. of gold, 53,394 oz. of silver, 651,597 lb. of lead and 44,913 lb. of copper, and had made a small profit for the company, but lack of capital prevented the development of the property on a scale that the mineral deposits seemed to warrant, and the mill has never been run at anything approaching its rated capacity because the power plant was too small to run both mining plant and mill. The Premier Company also has been negotiating for a controlling interest in Lorne Gold Mines and Pioneer Mines, which own properties along Cadwallader Creek in the Bridge River district. Lorne Gold Mines was a Stobie, Forlong Company promotion and has been idle since that company assigned. Prior to shutting down operations the company had erected a good camp, developed good water power, and driven a tunnel to open four veins at some 650 ft. below the old Lorne workings. The tunnel appears to have missed the first vein of the series but cut the second. A drive was run for about 800 ft. on the vein, 450 of which was in ore, and a rise was started to the old workings. The Pioneer mine has been developed by a shaft to a depth of 1,000 ft. and about 1,500 ft. laterally and now is producing well. Consequently the owning company is asking a higher price than the Premier Company thinks the mine is worth, and this constitutes a hitch in the present negotiations, as unless Premier can get control of the two companies, so that the whole property can be worked as one mine, it will not entertain either separately.

Peace River.—The Provincial Government, by Order-in-Council which went into effect in the end of September, has withdrawn the whole of the Peace River mining division from location for coal, petroleum, and natural gas. Some large blocks of land in the Peace River district were set aside by the late administration to be sold with the Pacific Great Eastern Railway, with the idea that they might serve as a land-settlement scheme, and induce either the Dominion Government or the Canadian Pacific Railway Company to take over the Pacific Great Eastern Railway and extend it into the Peace River district. These land grants were in unorganized territory and no one knew anything of their value. When the present administration came into power it induced the Canadian National Railway Company and the Canadian Pacific Railway Company to share with it equally in the cost of having the land grants surveyed and their possibilities determined. Several survey parties and two hydroplanes have been employed in this work for two seasons. The

work has just been completed and, though as yet no information as to the result has been made public, the reservation of the coal, oil, and natural gas in the area may mean that indications of some or all of these minerals may have been revealed by the surveys, and the Government may be holding these as an added inducement for one or both of the railway companies to take over the Pacific Great Eastern Railway which for long has been a serious drain on the Provincial exchequer.

TADANAC SMELTER, TRAIL, B.C.

TORONTO

October 17.

Porcupine.—The output of bullion from seven producing mines of the Porcupine area during September was valued at $1,416,573, from the treatment of 207,412 tons of ore, as compared with $1,260,860, from 211,547 tons of ore for the previous month. The Hollinger Consolidated is following a policy tending to preserve ore reserves, by drawing largely for mill feed upon a low grade of ore while treating enough high grade to yield a substantial profit to meet dividend requirements. There is a large tonnage of ore available which will run $7 or more to the ton. On the Schumacher section work to the depth of 4,040 ft. has disclosed a considerable quantity of ore, with indications of improvement at depth. The Dome mines will shortly resume production, the new mill having been completed. It has a capacity of 1,500 tons a day, as had the former equipment, and only the cyaniding process will be used, stamps being eliminated. A large saving in costs should be effected through the use of improved milling processes. Active underground development carried on during the year, while the mill remained closed, has assured a supply of ore for four years, nearly half the amount being already broken. The net earnings of McIntyre Porcupine, for the first six months of the financial year ending September 30, before depreciation were $1,026,276, as compared with $929,543 for the corresponding period of last year. Good progress is being made with the construction of the new mill, which is scheduled to be ready for operation by next May. It will have a capacity of at least 2,000 tons per day, which will give an increase of about one third over the present rate. Arrangements will be made to prevent any interruption in production during the change. During recent mining operations some rich ore pockets were opened up, one of them yielding approximately $40 per lb. of ore, which was sent directly to the furnace, yielding about $53,000.

Kirkland Lake.—The production of the Kirkland Lake gold area has been steadily increasing for several months, the output

of bullion for September being valued at $1,451,558, produced from 202,227 tons of ore, as against $1,397,780 from 202,589 tons of ore treated in August. At the Lake Shore the new mill is in steady operation treating about 1,700 tons a day, which will shortly be stepped up to 2,000 tons. Many improvements have been completed in underground equipment and the shaft completed to the 2,200 ft. level, the lowest in the mine. Three new ball-mills have been added, bringing the total to seven, and five new tube-mills increasing the number to eleven. The new equipment will permit of finer grinding and longer treatment of the ore, thus increasing the gold recovery. The Sylvanite has encountered two important new veins on the 400 ft. level, one of which averages $12 per ton over a width of 5½ ft., and the other $7 over 6 ft. Their downward continuation to the 1,000 ft. level has been proved. The structure for the new mill of the Teck-Hughes is practically completed and the new rod-mills are being installed. The south shaft, completed to the 3,600 ft. level, will give access to five virgin levels by the time the new mill unit is ready in May. The ore recently treated has been yielding an average of $16·50 per ton, though much of the mill feed was low-grade, drawn from the upper levels. Underground development at Wright-Hargreaves is meeting with favourable results. Driving on the north vein at the 2,250 ft. level has opened up an ore-shoot for a distance of 1,500 ft. while an off-shoot has been followed up for 400 ft. Ore has also been located at depth coming in from the Sylvanite adjoining. The Kirkland Lake gold mine is cross-cutting at the 4,150 and 4,275 ft. levels to prove the downward continuation of rich ore-deposits. Substantial profit is now being realized with the monthly recovery of approximately $50,000. The Barry-Hollinger, in the Boston Creek area, has practically exhausted the known ore above the 1,250 ft. level, rendering further exploration and deeper mining necessary. The mill is treating about 100 tons per day, with a recovery of about $7 per ton. In order to develop the 1,875 and 2,000 ft. levels additional hoisting equipment will be required.

Sudbury.—International Nickel has let a contract to the Frazer Brace Engineering Company for the construction of a refinery at Copper Cliff on which work has been commenced. The work of separating the copper from the nickel in the matte, now carried on at Port Colbourne, will be transferred to the new refinery on its completion, which will require about a year. This is in accordance with the policy of the company to concentrate operations near the smelter. It is announced that the company is making no change in their operating schedule in spite of unfavourable market conditions and they are treating approximately 150,000 tons of ore per month. Falconbridge Nickel is treating about 300 tons of ore per day, the smelter operating smoothly and efficiently, and about 75,000 tons of ore have been broken and placed in the stopes. Good progress is being made on the smelter addition which will not start producing until next year, when arrangements have been completed for necessary power supply. Underground developments continue at the 350 ft. level, where the ore-body has been opened up for a distance of about 300 ft., showing satisfactory widths of massive ore. A rise has been completed between the 350 and 225 ft. levels, providing a second opening to the surface. At the Errington Mine of the Treadwell Yukon, new mineralization has been encountered in the cross-cut on the 1,500 ft. level, but the ore is below commercial grade. Cross-cutting will be continued in the hope of improvement. The Delta Mines Syndicate has conducted 3,000 ft. of diamond drilling, encountering a mineralized zone carrying copper and nickel.

Rouyn.—Operations in the Rouyn copper area have latterly been much curtailed, as, owing to the low price of copper, work on many prospects which formerly appeared promising has been discontinued. The Noranda has let a contract for the erection of an addition to the smelter in which precious metals and other valuable by-products will be recovered from the smoke. The estimated cost will be about $200,000. An important discovery has been made on the 1,500 ft. level, where the ore in driving has widened to 12 ft. This is apparently a lens of good commercial ore, the deepest so far found on the property. Underground developments at the Waite-Montgomery between the 500 and 700 ft. levels have indicated the occurrence of a large tonnage of commercial ore and another new and apparently important ore-body has been indicated by diamond drilling between the depths of 800 and 1,000 ft. The Abana and Amulet mines have been temporarily closed down to await more favourable market conditions. At the Pandora gold mine a large programme

of development has been laid out and a three-compartment shaft will be put down to a depth of 500 ft. Operations are being actively maintained at the Siscoe and Granada.

Manitoba.—Much attention is being attracted to the discoveries of beryl in south-eastern Manitoba, which are regarded as important in view of the demand for beryllium, the lightness and strength of this metal rendering it valuable for alloying purposes. The most important deposit is on the property of the Winnipeg River Mine Company located about 100 miles north of Winnipeg. This has been opened up on the surface for a length of 100 and a width of 50 ft. Several large companies are anxious to secure a controlling interest in this property, and the company is prepared to deal with the highest bidder. The Beryllium Corporation, an American company, is keenly interested, and a syndicate of British bankers is also in the field, the industrial possibilities in view being regarded as of sufficient consequence to form the subject of a report to the Imperial Economic conference. The occurrence of beryl has also been indicated on the property of the Shatford Basin Mines, Ltd. in the same locality.

Operations in the concentrator of the Flin Flon Mine of the Hudson Bay Mining and Smelting Company have reached half capacity and will be gradually brought up to the designed rate of 3,000 tons per day. The mill of the Sherritt-Gordon is expected to go into operation early in January, with a daily capacity of 1,800 tons. The ore will be drawn entirely from the Ook shaft. Driving and cross-cutting from the main shaft are stated to have shown improvement in the ore-bodies. Mineral Discoverers, Ltd. has taken over on option a group of five claims at Morton Lake on which there are stated to be good gold showings and active development will be undertaken.

PERSONAL

R. Allan has left for West Africa.

William Brown is home from the Straits Settlements.

B. S. W. Buffam has left Rhodesia for Ontario.

A. C. Clarke is returning from Yugoslavia.

A. D. Combe is leaving Uganda for the Dutch East Indies on his way home to New South Wales.

Nigel C. Cooke has left for Nigeria.

N. F. Dare is home from Malaya.

Alfred R. Dewar is home from Nigeria.

P. St. John Dixon has left for a short visit to the Gold Coast.

J. V. N. Dorr has returned to the United States.

G. T. Eve is leaving for Manchuria.

G. H. Fairmaid has left Malaya for New Zealand.

G. R. Fulton has left for Sierra Leone.

James Gibson has left Colombia for California.

B. C. W. Gullachsen is returning from Panama.

H. C. Herbert has left for India.

Vincent T. Hockin is returning from Tanganyika.

Ross B. Hoffmann has left for New York.

C. E. Jordan is returning from Tanganyika.

N. R. Junner has left for the Gold Coast to take up his appointment as director of the Geological Survey.

H. R. Mitchell has left for Nigeria.

M. T. O'Regan is home from Yugoslavia.

J. Scott Park has left for Nigeria.

John Parkinson has left for British Somaliland.

Ernest Parsons is returning from Tanganyika.

Walter G. Perkins is leaving on the 21st inst. for Northern Rhodesia.

James Russell is leaving for Bolivia.

W. J. Shephard has returned from British Guiana.

P. O. Shiel is leaving the Straits Settlements for New Zealand.

W. C. Simmons has left for Uganda.

J. Stuart Smith is home from Ecuador.

H. A. Titcomb has returned from the United States.

A. H. E. Turner has returned to the Gold Coast.

W. G. Tyson has returned from Indo-China.

N. L. Wimmler is returning to California from Siberia.

H. W. Yates is home from France.

Arthur R. Brown died on October 20 at the age of 66. He was the founder and managing director of the firm of dredge designers that bears his name.

James Vincent Elsden died on October 31 at the age of 74. He was joint editor of the *Colliery Guardian* and also for some time joint editor of *Fuel in Science and Practice*. He was educated at Hertford Grammar School and the Royal School of Mines, and from 1910 to 1915 served on the Council of the Geological Society, of which he was treasurer from 1916 to 1921.

TRADE PARAGRAPHS

G. and J. Weir, Ltd., of Cathcart, Glasgow, send us a booklet giving particulars and many illustrations of their high pressure boiler-feed pumps of centrifugal type arranged for drive by steam turbine, combined steam turbine and electric motor, or electric motor only.

Austin Hoy and Co., Ltd., announce the opening of their office in Bush House, Strand, London, W.C. 2. The managing director, Mr. Austin Y. Hoy, was for 26 years connected with the Sullivan Machinery Company, during the last 17½ of which he was their London manager.

Arthur R. Brown, Ltd., of 54, New Broad Street, London, E.C. 2, inform us that the death of their founder and managing director will not be allowed to interfere with their business, which will continue with the same staff. Mr. A. C. Faunce-Brown, the son of the deceased, is a director of the company.

Bureau of Information on Nickel of the Mond Nickel Co., Ltd., of Imperial Chemical House,

London, S.W. 1, issue booklets devoted to the condenser-tube corrosion problem, and the use of nickel in automobile engineering. Their *Nickel Bulletin* for October contains an article on nickel coinage.

British Industries Fair.—This is being held as in former years simultaneously at Birmingham and in London from February 16 to 27. The Birmingham section, in which engineers will be more particularly interested, should be just as attractive as hitherto and it will contain more exhibits than ever before.

Hadfields, Ltd., of Sheffield, issue a leaflet describing their patent "Springless" tub-axle greaser, which consists of a metal box containing grease or heavy oil, in which runs a wheel with a corrugated rim for conveying the lubricant to the tub axle journal, and a steel brush for wiping away surplus grease.

Dressing and Screening Co., Ltd., of 116, Victoria Street, London, S.W. 1, publish a booklet covering some 70 pages describing their "Drescol" sieves and also their "Rima" sieves and all sorts of screens and other sizing equipment. Grizzly bars and suchlike are fully described and also metal conveyor belts.

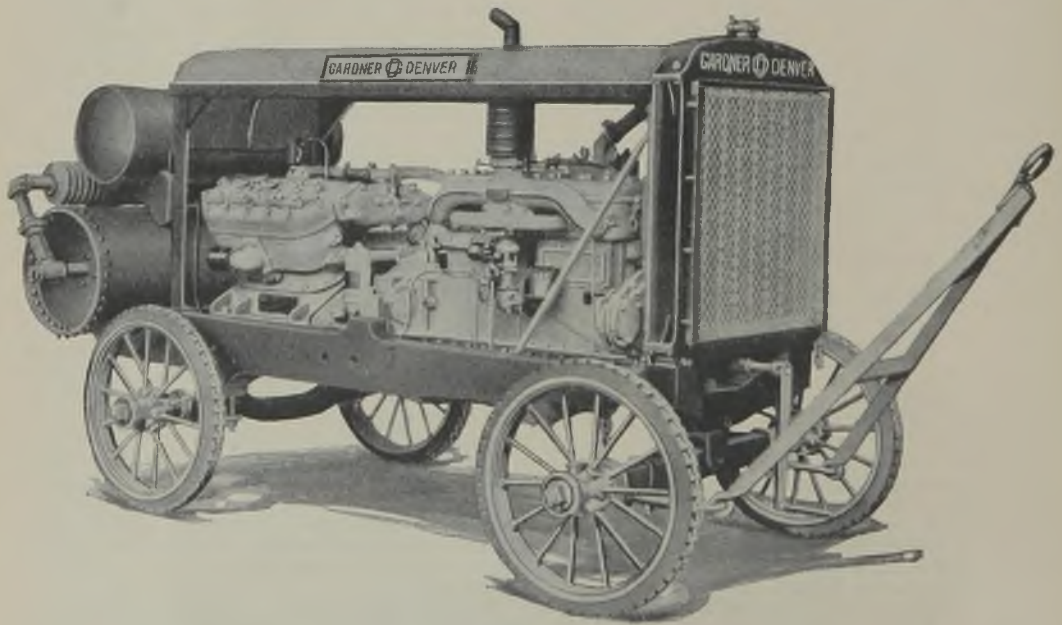
Ross Patents, Ltd., of 2, Victoria Street, London, S.W. 1, which is associated with the **Ross Screen and Feeder Co.** of New York, issue a fully illustrated catalogue of their various feeders and screens for the handling of material in bulk for hopper discharges into crushers or on to conveyors. The broad principles on which these specialities are designed were described here in the issues of February 1926 and September 1927.

Liquid Oxygen Explosives, Ltd., of 1, Albemarle Street, London, W. 1, send us a recent edition of their descriptive booklet which gives a history of the development of liquid oxygen as an explosive, records some present-day results with Weber cartridges at the Lorraine mines and also some tests in England at Cleveland and Frodingham, and describes the cartridge itself in some detail and how it is used. Particulars of the manufacture of liquid oxygen are also given and finally various other uses of the explosive are discussed.

Samuel Osborn and Co., Ltd., of Clyde Steel Works, Sheffield, issue a number of booklets devoted to the following: Corrosion resisting steel, rustless plastic iron, rustless steel, "Tropic" fireproof steel, acid resisting and deep drawing steel. The booklets are illustrated with examples of these products and contain the usual particulars of heat treatment necessary. They also send us a copy of their 25th annual report, which discloses a balance of profit for the year ended July 31, 1930, of £35,000, which permits a carry forward of £21,000, the same as last year.

Head, Wrightson, and Co., Ltd., of Stockton-on-Tees, send us a booklet devoted to the Notanos tube mill, the grinding media in which are flint pebbles. This mill has become the standard machine for fine grinding, especially in the cyanide process. The fineness to which it will grind is stated to be practically unlimited, but it is seldom necessary to reduce ores finer than 150 or 200 mesh. The mill is frequently placed in closed circuit with an Akins classifier. They send us also a booklet devoted to the Colorado convertible discharge ball-mill which, as is pointed out, has come into favour for crushing ores for various concentration processes because of its simplicity and ability to make a large size reduction in one operation.

Edgar Allen and Co., Ltd., of Sheffield, issue booklets describing lime hydrators or slaking machines and Stag ball-mills for dry and wet crushing with forged steel balls. Their *Edgar Allen News* for October contains an article giving notes on bucket elevators. They also publish a second edition of their Mine and Quarry Book. This covers some 50 pages and contains sections as follows: Notes on crushing and grinding machinery,



GARDNER-DENVER TRANSPORTABLE AIR-COMPRESSOR.

spares for mine and quarry, notes on mining drill steels, and steels for granite tools. The first section contains particulars in brief of all the various crushing machines made by the firm, together with such plant as air separators, conveyors and elevators, and section two gives details of the manganese steel and other replaceable wearing parts. The book is very fully illustrated with photographs and cross-sectional drawings.

GARDNER-DENVER COMPRESSORS

Gardner-Denver Co., Ltd., of 3, Wilson Street, London, W.C. 2 issue a catalogue devoted to their portable air-compressors. These are made in four sizes known as Class 110, Class 160, Class 220 and Class 310 respectively. The first is fitted with a Buda, model KTU, four-cylinder petrol engine of 25 h.p. and the compressor is a vertical two cylinder single acting type of 18 h.p. which delivers 110 cu. ft. of air per minute at 100 lb. pressure. The second is fitted with a similar petrol engine, YTU type, of 37 h.p. and the compressor is of the same type of 25 h.p. delivering 160 cu. ft. of air per minute at 100 lb. pressure. The third, which is illustrated in the accompanying photograph, has a 47 h.p. Buda engine, BTU type, and the compressor of 35 h.p. delivers 220 cu. ft. of air per minute at 100 lb. pressure. The last named is driven by a 70 h.p. Buda engine, type JV, has a compressor rated at 51 h.p. and delivers 310 cu. ft. of air per minute at 100 lb. pressure. Each type is fitted, as may be seen, with an air receiver of suitable size, that shown being 20 in. by 60 in. They are mounted for road or rail and are also made in semi-portable types.

A NEW WERF CONRAD DRILLING RIG

Werf Conrad, of Haarlem, Holland, have recently introduced some new types of drilling machines. The universal call for more efficient drilling machinery induced the makers to design a quickly transportable plant, easy to rig and to work, and of low initial and operating cost.

A useful machine has been created by the combination of a motor lorry and drilling apparatus, the motor of the lorry being used to drive the drill. This combination offers obvious advantages, as no second driving unit is required and the weight of the plant is considerably reduced. Moreover, the lorry motor with its gearbox constitutes an ideal drive for the purpose as it is easy to handle and flexible and runs smoothly. The lighting outfit of the lorry can also be used to advantage for lighting the plant after dark. As the successful application of the lorry was only possible if a reliable transmission of the motor power to the drilling machinery was found, a new and very simple construction was employed. No alterations are made on the chassis, and as the drill is simply clamped to it, the latter can always be used for ordinary transport work, if the drill is out of use for some time.

Core-drilling machines (Fig. 3) as well as cable-tool drillers (Fig. 1) are built according to these principles, a 1,000 ft. and a 2,000 ft. type of the first and a 300 ft. and 500 ft. type of the second. The smaller drills are placed on a 2½-ton lorry with twin rear wheels, the larger on 4½-ton lorries with double rear axles.

When the drill arrives on the location the rear axle is lifted from the ground by means of a pair of screw jacks and one of the twin wheels on each side is taken off and placed on each end of the main shaft. For the larger size, the wheels of the second rear axle are dismounted. The main shaft is placed in such a position that the tyres of the wheels of the rear axle touch those of the wheels placed on the main shaft and act as friction drivers (Fig. 2). A slight difference in the diameter of the wheels has no influence on the true running, as it is equalized by the differential gear of the rear axle. The pressure between the friction wheels required to transmit the power is produced through the wagon springs by means of a simple combination of levers. Thus the pressure exerted by this device is flexible and adjustable. This power trans-

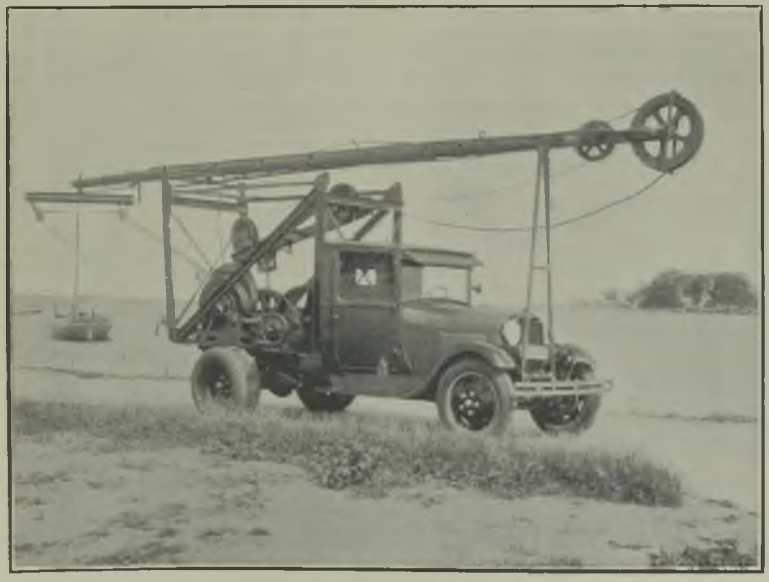


FIG. 1.

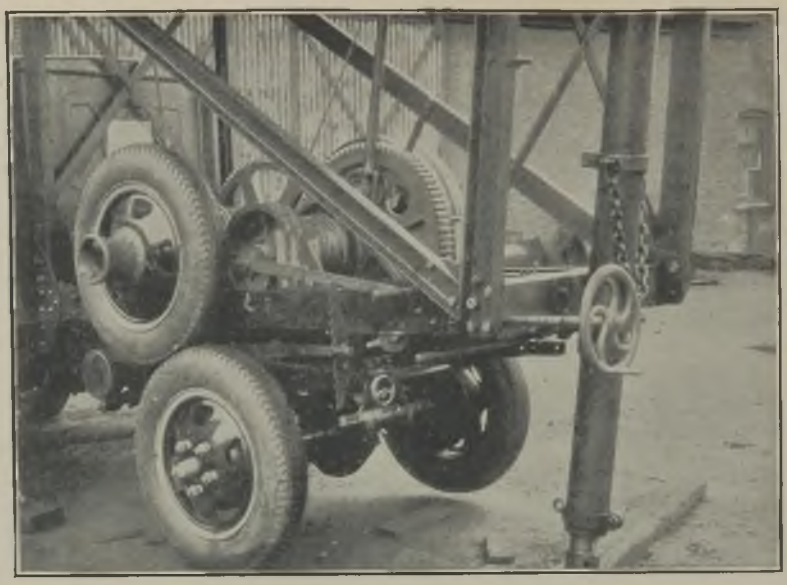


FIG. 2.

mission, which eliminates all belts, chains or gear-wheels has been found to be satisfactory in all respects. When the wheels are mounted, the derrick or mast can be raised with the hoist on the machine (Fig. 3) and about 20 minutes after arrival on the bore site drilling can be started.

The design of the core-drilling machines shows some new features and is based on modern construction principles. All the gearings are enclosed in oil-tight castings. They are made of solid steel with tempered and ground teeth, running on ball bearings in an oil-bath, by which means long life, efficiency, and smooth running are ensured. For the same reasons, and more especially for quick lowering of the tools, the hoist drum also runs on ball bearings.

All the controllers for the drill, pump, and motor are centralized at the rear or drilling end of the lorry. The drilling head can be brought forward and backward by the hydraulic pressure of the pump; if it is moved backward against the lorry chassis, there is ample room around the bore-hole for lowering the tools or to handle the casing.

For controlling the feed of the bit a new and very sensitive hand-feeding device is fitted to the drill head which enables the driller constantly to follow the running of the bit on the bottom of the hole and to lift it a little as soon as vibrations that may endanger the setting occur, an essential feature to keep down the cost of operation when drilling with diamond bits. The drilling head can be turned at an angle, allowing drilling in any direction.

The larger sized core-drilling machine, more especially built for deep-structure testing in oil-fields, is equipped with a grief stem, or Kelly, for fish-tail work through the softer formations, while the pressure pump is built for mud injection.

The cable-tool machines (Fig. 1), are designed for making water wells, blast holes and for general prospecting work. This machine is a so-called

FIG. 3.

spudding machine and built according to the same principles as the core driller. A new feature in this type of drill is the wagon spring shock-absorber on the spudder, with adjustable spring pressure and the stroke restricted by rubber cushions. The application of a shock absorber on the spudder has several advantages: It does away with the manilla rope, which wears away rapidly, and a wire line can be used for drilling instead; the blows of the bit are more elastic, which ensures quick drilling; and, last but not least, it protects the machine against early wear and damage caused by the continuous shocks of the drilling mechanism.

METAL MARKETS

Copper.—During October the electrolytic copper market in New York was easy and the official quotation was marked down from 10 cents to 9·50 cents per lb. Demand was restricted during the major portion of the month on both sides of the Atlantic, the European situation being made worse by the strike which broke out in the Berlin metal consuming works. During the last few days of October, however, European purchasing expanded substantially and, despite the huge stocks which it held, the Copper Cartel adopted its usual policy of "rationing" buyers. A meeting took place at New York at the end of the month at which copper producers from all parts of the world were represented, one of the matters on the agenda being the question of output-curtailment. The outcome of this conference was eagerly awaited and may have considerable effect ultimately on the copper position. The Standard Copper market in London was comparatively steady throughout October.

Average price of Cash Standard Copper: October, 1930, £43 1s. 5d.; September, 1930, £46 6s.; October, 1929, £72 17s. 2d.; September, 1929, £75 6s. 9d.

Tin.—The market was decidedly easy until the middle of October, when the tendency improved somewhat. Sentiment has become somewhat less pessimistic than it was owing to the realization that the position has already improved to some extent as a result of the curtailment of output at so many of the mines. For the time being world stocks are certainly not being added to seriously. On the other hand, the two-months "holiday" is over and although the Tin Producers' Association is credited with having some fresh and even more drastic scheme in contemplation, there is obviously a possibility that in the near future supply will again outstrip consumption. In any case, the world "visible supplies" are very substantial and must hang over the market as a veiled menace for a considerable time to come. Meanwhile, consumption is not too good either in Europe or America.

Average price of Cash Standard Tin: October, 1930, £117 11s. 1d.; September, 1930, £132 14s.; October, 1929, £190 17s. 7d.; September, 1929, £204 18s. 9d.

Lead.—Prices fluctuated considerably during October, a sharp downward movement early in the month being followed by rather firmer conditions later. At the lowest figure touched (£14 18s. 9d. for prompt, which was the worst price witnessed since 1911) consumers took a certain amount of additional interest, but the recovery which subsequently took place was probably mainly a sympathetic movement connected with developments on the other non-ferrous metal markets. Arrivals of fresh metal into this country were fairly full, but not exceptionally heavy. Producers the world over are, of course, handicapped by extensive stocks and this acts as a drag on the market. Lead has continued to command a higher price than spelter, but the margin between the two metals has latterly tended to shrink.

Average mean price of soft foreign lead: October, 1930, £15 14s. 2d.; September, 1930, £17 17s.; October, 1929, £23 4s. 9d.; September, 1929, £23 11s. 5d.

Spelter.—Despite the price-fluctuations which took place during October, this market remained fairly steady, on balance. Demand from consumers was not brilliant and there was no lack of supply, despite the curtailment which has already been effected in production. Sentiment was cheered, however, by the possibility of a definite agreement being secured amongst producers in their endeavour to re-establish the Zinc Cartel. The negotiations which took place during October were made difficult by objections put forward by two big European makers and it is not yet quite certain whether these difficulties will be quickly surmounted. The price of spelter is now so low, however, that it looks as if the less economic producers will be squeezed out of existence if an international arrangement is not made for further limiting production, so that the spelter market is likely to enter into a distinctly healthier phase in the not distant future.

Average mean price of spelter: October, 1930, £14 13s. 9d.; September, 1930, £15 18s. 5d.; October, 1929, £23 2s. 6d.; September, 1929, £24 8s. 11d.

Iron and Steel.—Conditions in the British pig-iron industry during October were far from brilliant, the Cleveland district being perhaps the most favoured spot as the blast furnaces there, owing to their drastic curtailment of output and a fairly good demand, found they were able to dispose of current output without much difficulty, which was not the case with plants in other parts of industrial Britain. Cleveland No. 3 foundry remained at 63s. 6d. minimum. Hematite was a fair market with East Coast Mixed Numbers quoted at 71s. per ton. British finished iron and steel was dull, though a certain amount of business was effected. The Continental steel market remained easy. The Continental Raw Steel Cartel was provisionally renewed until the end of the year, but its ultimate fate still seems rather uncertain.

Iron Ore.—Demand has remained stagnant and prices have fallen further. More blast furnaces have been blown out during the past month and most works are covered for months ahead. Best Bilbao rubio is about 16s. 3d. to 16s. 6d. per ton c.i.f.

Antimony.—At the close of October English regulus was quoted at from about £36 up to about £46 per ton, while there was a moderate inquiry for Chinese regulus at about £26 ex warehouse for spot and about £24 7s. 6d. c.i.f. for shipment material.

Arsenic.—With the closing down of Cornish tin mines the arsenic output has been materially affected and prices have risen to about £18 7s. 6d. per ton f.o.r. mines. Mexican is still quoted at about £17 to £17 10s. c.i.f.

Bismuth.—The official price is without alteration at 4s. per lb. for 5 cwt. lots and over.

Cadmium.—Continental competition has con-

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.	3 Months.			Cash.	3 Months.				Cash.	Forward.	
Oct.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	s. d.
13	42 16 10½	42 16 10½	46 15 0	—	113 12 6	114 17 6	14 2 6	15 12 6	17 0 0	16⅜	16⅜	84 11½
14	42 5 7½	42 5 7½	46 15 0	45 5 0	109 12 6	111 2 6	14 3 9	15 6 3	16 15 0	16 11/16	16 11/16	84 11½
15	42 11 3	42 11 10½	46 15 0	—	110 11 3	111 16 3	14 5 0	15 7 6	16 15 0	16 11/16	16 11/16	84 11½
16	42 18 1½	42 19 4½	46 15 0	—	113 1 3	114 12 6	14 15 0	16 0 0	17 10 0	16 11/16	16 11/16	84 11½
17	42 16 10½	42 18 1½	46 15 0	45 5 0	115 10 0	116 17 6	15 0 0	15 15 0	17 5 0	16⅜	16⅜	84 11½
20	42 16 3	42 16 10½	46 15 0	—	114 12 6	116 3 9	15 0 0	15 13 9	17 5 0	16 7/16	16 7/16	84 11½
21	43 9 4½	43 7 6	46 15 0	45 5 0	118 10 0	120 2 6	14 17 6	15 17 6	17 5 0	16⅝	16⅝	85 0½
22	42 14 4½	42 13 9	46 10 0	—	119 2 6	120 12 6	14 8 9	15 17 6	17 5 0	16½	16½	85 0½
23	41 16 3	41 16 10½	46 0 0	—	115 17 6	117 7 6	14 2 6	15 10 0	17 0 0	16⅝	16⅝	85 0½
24	41 8 1½	41 6 10½	45 0 0	43 15 0	116 17 6	118 6 3	14 5 0	15 7 6	16 15 0	16½	16½	84 11½
27	41 13 1½	41 13 1½	44 15 0	—	117 12 6	119 2 6	14 5 6	15 11 3	17 0 0	16 7/16	16 7/16	84 11½
28	42 0 0	41 18 9	44 15 0	43 15 0	118 18 9	120 6 3	14 3 9	15 7 6	16 15 0	16⅛	16⅛	85 0⅛
29	43 1 3	42 16 10½	44 15 0	—	118 8 9	119 18 9	14 6 3	15 10 0	17 0 0	16½	16½	85 0
30	43 13 9	43 8 9	44 15 0	—	118 16 3	120 6 3	14 15 0	15 15 0	17 0 0	16½	16½	85 0
31	44 1 3	44 0 7½	45 15 0	44 15 0	118 3 9	119 11 3	14 15 0	15 16 3	17 0 0	16 7/16	16 7/16	85 0
Nov.												
3	43 15 0	43 10 7½	45 15 0	—	114 0 0	115 7 6	14 13 9	15 15 0	17 0 0	16⅜	16 11/16	85 0¼
4	43 13 1½	43 8 1½	45 15 0	44 10 0	111 6 3	112 13 9	15 1 3	15 16 3	17 5 0	16 11/16	16⅜	85 0⅜
5	42 18 1½	42 16 3	45 15 0	—	111 11 3	112 18 9	14 17 6	15 16 3	17 5 0	16 11/16	16⅜	85 0½
6	43 4 4½	43 3 9	45 15 0	—	113 2 6	114 12 6	15 2 6	15 15 0	17 5 0	16½	16 11/16	85 0¾
7	43 9 4½	43 8 1½	45 15 0	44 10 0	112 3 9	113 11 3	14 13 9	15 10 0	17 0 0	16⅜	16 11/16	85 0¾
10	44 9 4½	44 9 4½	45 15 0	—	112 1 3	113 6 3	14 13 9	15 10 0	17 0 0	16 11/16	16 7/16	85 1⅛

tinued and further reductions in prices have been made. Current quotations are about 2s. 1d. to 2s. 2d. per lb. for fair-sized quantities.

Cobalt Metal.—The official price is still 10s. per lb., but demand is distinctly slow.

Cobalt Oxides.—There is no change in quotations, which stand at 8s. per lb. for black and 8s. 10d. for grey.

Chromium Metal.—The growth of chromium plating in the motor car and other industries results in a fairly good demand, prices keeping steady at 2s. 6d. per lb.

Tantalum.—Little interest is shown in this article at the moment, with the price around £40 to £50 per lb.

Platinum.—The position of this market has not changed materially during the past month, the official price of refined metal being still £7 per oz. The negotiations between producers are still proceeding, and latterly a fair demand has been in evidence.

Palladium.—This market is quietly steady at £3 15s. to £4 per oz.

Iridium.—Only a limited interest is evinced in this metal, but quotations remain steady at £37 to £39 per oz. for sponge and powder.

Osmium.—Supplies are not particularly plentiful and the price has had a harder tendency, about £16 to £16 10s. per oz. representing the current value.

Tellurium.—There is nothing moving and quotations are nominal in the region of 12s. 6d. per lb.

Selenium.—A steady business is passing in high grade black powder at the unaltered price of 7s. 8d. to 7s. 9d. per lb. ex warehouse.

Manganese Ore.—There is still very little inquiry from consumers, most of them being covered well ahead, whilst in some cases they are holding stocks accumulated from current contracts. Prices are in the neighbourhood of 11½d. to 11¾d. per unit c.i.f. for washed Caucasian ore and 1s. to 1s. 1d. for best Indian.

Aluminium.—The feature of the past month was, of course, the reduction in the price of the European Consortium on October 16 to £85 per ton, less 2%, for ingots and bars. This was brought about by Continental producers, British makers being opposed to the reduction. So far no material expansion in demand has resulted.

Sulphate of Copper.—Quotations eased further during the past month, English material being quoted at £21 to £21 10s. per ton, less 5%.

Nickel.—There is not a great deal of demand, but leading interests have announced officially that there is no prospect of a reduction in prices, which remain at £170 to £175 per ton for both home and export.

Chrome Ore.—Demand has quietened down, especially in the metallurgical trades and quotations if anything have a rather easier tendency. Good 48% Rhodesian ore is now priced at about £4 c.i.f. with 55% New Caledonian held for around £4 15s. to £5 c.i.f.

Quicksilver.—Inquiry has been on a most restricted scale recently, but producers have firmly maintained prices at the current level of £22 12s. 6d. to £22 15s. per bottle, full terms.

Tungsten Ore.—Seldom has there been such a marked absence of demand and although sellers have reduced their prices to about 18s. to 18s. 6d. per unit c.i.f. for forward shipment Chinese ore, buyers refuse to be tempted.

Molybdenum Ore.—Contract prices remain about 35s. 6d. per unit c.i.f., but small parcels are still offering at around 32s. 6d. to 33s. per unit, for 80 to 85% concentrates.

Graphite.—Demand has fallen away, but the better qualities keep pretty steady at about £25 to £27 c.i.f. for 85 to 90% Madagascar flake, and £24 to £26 c.i.f. for 90% Ceylon lumps.

Silver.—On the whole October was an uneventful month in the silver market, business being of small dimensions. On October 1 spot bars were 16⅜d., but with Indian inquiry after a period of prolonged quietness quotations rose to 16 11/16d. on October 14. In the absence of any appreciable inquiry during the second half of the month quotations had a rather easier tendency, spot bars closing at 16 7/16d. on October 31.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
October, 1929	853,609	35,081	888,690
November	827,952	33,641	861,593
December	813,574	37,560	851,134
January, 1930	848,245	34,556	882,801
February	783,086	35,102	818,188
March	852,089	37,281	889,370
April	831,996	36,610	868,606
May	876,893	39,320	916,213
June	847,352	40,515	887,867
July	871,468	41,184	912,652
August	878,474	42,607	921,081
September	860,311	42,865	903,176
October	884,632	41,929	926,561

TRANSVAAL GOLD OUTPUTS.

	September.		October.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	87,500	£139,068	92,600	£147,873
City Deep	96,500	26,426	98,500	26,391
Cons. Main Reef	59,500	21,242	63,000	22,290
Crown Mines	248,000	78,198	258,000	80,288
D'rb'n Roodepoort Deep	44,600	15,095	46,000	15,133
East Rand P.M.	153,000	41,296	157,000	42,093
Geduld	83,500	26,704	86,000	27,520
Geldenhuis Deep	68,500	15,665	71,100	16,212
Glynn's Lydenburg	6,200	1,879	6,000	2,029
Government G.M. Areas	205,000	£396,385	211,000	£412,645
Kleinfontein	50,900	10,884	51,300	11,106
Langlaagte Estate	80,000	£115,661	84,000	£117,343
Luipaard's Vlei	29,900	7,700	32,000	8,189
Meyer and Charlton	17,800	£17,957	18,300	£18,339
Modderfontein New	158,000	71,253	166,000	73,488
Modderfontein B	69,000	24,317	71,500	24,728
Modderfontein Deep	44,200	22,880	45,900	23,832
Modderfontein East	71,000	20,245	72,500	20,724
New State Areas	78,000	£161,693	82,000	£171,204
Nourse	66,500	19,381	68,000	19,869
Randfontein	220,000	£240,842	221,000	£246,612
Robinson Deep	95,500	27,589	95,400	27,995
Rose Deep	62,000	13,351	64,500	13,742
Simmer and Jack	78,300	20,943	81,600	22,103
Springs	71,000	£142,007	75,500	£154,391
Sub Nigel	30,900	27,557	31,000	27,905
Transvaal G.M. Estates	14,450	5,338	15,280	5,122
Van Ryn	41,000	£40,884	42,500	£42,186
Van Ryn Deep	67,000	£106,106	68,000	£109,632
West Rand Consolidated	91,500	£102,698	93,000	£107,981
West Springs	68,800	£76,544	71,600	£79,721
Witw'tersr'nd (Knights)	55,000	£50,514	56,500	£52,334
Witwatersrand Deep	40,200	12,626	44,500	13,983

COST AND PROFIT ON THE RAND, Etc.

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

	Tons milled.	Yield per ton.	Work'g cost per ton.	Work'g profit per ton.	Total working profit.
		s. d.	s. d.	s. d.	£
July, 1929	2,649,560	28 1	19 8	8 5	1,112,246
August	2,661,800	28 1	19 9	8 4	1,111,834
September	2,530,370	28 2	19 10	8 4	1,056,839
October	2,658,100	28 1	19 8	8 5	1,115,744
November	2,559,450	28 3	19 11	8 4	1,071,199
December	2,528,000	28 3	19 11	8 4	1,058,231
January, 1930	2,618,600	28 2	19 9	8 5	1,103,718
February	2,421,100	28 5	20 0	8 5	1,019,482
March	2,663,820	28 1	19 8	8 5	1,121,216
April	2,549,250	28 7	20 1	8 6	1,084,504
May	2,741,634	28 1	19 8	8 5	1,153,549
June	2,651,970	28 2	19 7	8 7	1,141,197
July	2,706,900	28 5	19 8	8 9	1,184,107
August	2,693,100	28 3	19 6	8 9	1,174,828
September	—	—	—	—	1,160,430

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
October 31, 1929	189,739	15,533	4,555	209,827
November 30	186,941	15,320	4,561	206,822
December 31	184,280	15,326	4,811	204,417
January 31, 1930	190,663	15,288	5,889	211,840
February 28	196,752	15,495	6,584	218,831
March 31	200,134	15,350	7,002	222,316
April 30	202,434	15,109	5,565	223,108
May, 31	202,182	15,028	5,340	222,550
June 30	201,324	14,943	5,126	221,393
July 31	201,111	14,670	5,490	221,271
August 31	202,257	14,788	5,754	222,799
September 30	205,061	14,706	5,767	225,534
October 31	206,778	14,482	5,032	226,292

PRODUCTION OF GOLD IN RHODESIA.

	1927	1928	1929	1930
	oz.	oz.	oz.	oz.
January	48,731	51,356	46,231	46,121
February	46,461	46,286	44,551	43,385
March	50,407	48,017	47,388	45,511
April	48,290	48,549	48,210	45,806
May	48,992	47,323	48,189	47,645
June	52,910	51,762	48,406	45,208
July	49,116	48,960	46,369	45,810
August	47,288	50,611	46,473	46,152
September	45,838	47,716	45,025	46,151
October	46,752	43,056	46,923	—
November	47,435	47,705	46,219	—
December	49,208	44,772	46,829	—

RHODESIAN GOLD OUTPUTS.

	September.		October.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	24,200	10,692	24,400	10,630
Globe and Phœnix	6,060	5,116	6,039	5,103
Lonely Reef	5,900	3,766	6,300	3,802
Luiri Gold	1,607	£2,021	—	—
Rezende	6,400	2,709	6,400	2,700
Sherwood Star	5,000	£12,776	5,000	£12,852
Wanderer Consolidated	15,151	3,876	15,900	4,102

WEST AFRICAN GOLD OUTPUTS.

	September.		October.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	—	—	—	—
Ashanti Goldfields	10,816	12,959	11,390	13,238
Taquah and Abosso	9,870	£15,907	10,010	£16,012

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.
	Oz.	Oz.	Oz.
October, 1929	35,445	—	789
November	28,460	—	473
December	33,650	1,459	1,636
January, 1930	25,472	952	209
February	31,307	1,354	350
March	27,946	2,562	382
April	36,652	1,812	1,081
May	32,967	3,480	580
June	41,738	812	673
July	34,174	2,327	728
August	38,579	1,864	323
September	32,034	—	—
October	39,687	—	—

AUSTRALASIAN GOLD OUTPUTS.

	September.		October.	
	Tons.	Value £	Tons	Value £
Associated G.M. (W.A.)	5,351	7,683	6,195	8,868
Blackwater (N.Z.)	3,700	6,068	—	—
Boulder Persev'ce (W.A.)	6,908	17,229	7,404	15,393
Grt. Boulder Pro. (W.A.)	8,823	22,740	9,851	23,893
Lake View & Star (W.A.)	7,668	16,825	—	—
Sons of Gwalia (W.A.)	13,488	14,281	13,648	14,694
South Kalgurli (W.A.)	8,364	14,817	8,594	15,790
Waihi (N.Z.)	18,462§	{ 6,492* / 40,902†	17,235‡	{ 5,834* / 36,672†

* Oz. gold. † Oz. silver. ‡ To October 18. § To Sept. 20.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	September.		October.	
	Tons Ore	Total Oz.	Tons Ore	Total Oz.
Balaghat	3,950	1,950	3,300	1,950
Champion Reef	8,460	5,872	8,760	5,861
Mysore	17,397	8,752	17,969	9,694
Nundydroog	11,500	7,021	11,598	7,585
Ooregum	13,500	5,704	13,500	5,734

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	September.		October.	
	Tons	Value £	Tons	Value £
Chosen Corp. (Korea)	9,870	14,650	10,270	14,070
Frontino & Bolivia (C'lbia)	2,400	10,577	2,570	10,670
Lena (Siberia)	—	—	—	—
Lydenburg Plat. (Trans.)	4,150	1,112*p*	4,250	1,062
Marmajito (Colombia)	900	5,135	1,010	5,941
Fresnillo	95,817	23,150*d*	—	—
Onverwacht Platinum	—	—	—	—
Oriental Cons. (Korea)	17,073	81,165*d*	—	81,315*d*
St. John del Rey (Brazil)	—	44,500	—	41,000
Santa Gertrudis (Mexico)	44,092	86,814*d*	—	—

d Dollars. *p* Oz. platinoids.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

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

January, 1930	6,128	July	5,525
February	4,768	August	4,153
March	5,763	September	4,048
April	5,407	October	4,807
May	6,043	November	—
June	5,590	December	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	August.	Sept.	Oct.
Ayer Hitam	—	—	59½
Batu Caves	—	27	—
Changkat	—	—	50
Chenderiang	—	—	—
Gopeng	67	71½	65
Hongkong Tin	23¾	110	77
Idris Hydraulic	—	23¾	25½
Ipoh	—	—	40½
Jelapang	29¾	—	—
Kampar Malaya	—	—	86
Kampong Lanjut	—	86	158
Kamunting	99	98½	—
Kent (F.M.S.)	30	36	39
Kepong	—	—	—
Kinta	13	21	27
Kinta Kellas	—	—	23¾
Kuala Kampar	—	40	105
Kundang	—	—	—
Lahat	18	—	—
Larut Tinfields	—	—	—
Malaya Consolidated	69½	72½	75½
Malayan Tin	—	—	125
Meru	18	12	—
Pahang	225½	225⅝	225½
Penawat	78½	75⅝	226½
Pengkalen	71⅛	71⅛	65⅛
Petaling	149	131	234
Rahman	65½	59½	59½
Rambutan	9	9	9½
Rantau	—	—	—
Rawang	—	48	90
Rawang Concessions	27	30	70
Renong	—	—	37
Selayang	—	—	—
Southern Malayan	—	—	—
Southern Perak	—	—	29¾
Southern Tronoh	—	—	59
Sungei Besi	—	—	39
Sungei Kinta	15½	—	22
Sungei Way	—	—	83½
Taiping	—	—	—
Tanjong	30	46	—
Teja Malaya	30	23	29½
Tekka	32	32	36
Tekka-Taiping	45	40½	41½
Temoh	—	—	—
Tronoh	—	—	108

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	August.	Sept.	Oct.
Amari	—	—	—
Anglo-Nigerian	51	46	—
Associated Tin Mines	80	80	130
Baba River	3	3	—
Batura Monguna	3½	2½	—
Bisichi	65	40	40
Daffo	10	11	16
Ex-Lands	—	—	—
Filani	7½	10½	—
Jantar	15	15	15
Jos	20½	19½	27½
Juga Valley	6	6	6
Junction	—	—	—
Kaduna Syndicate	13	13	—
Kaduna Prospectors	13	13	—
Kassa	20½	20½	—
London Tin	75	80	220
Lower Bisichi	11	10½	8½
Naraguta	—	—	—
Naraguta Durumi	—	—	—
Naraguta Extended	—	—	—
Naraguta Karama	—	—	—
Naraguta Korot	—	—	—
Nigerian Consolidated	14	14	14
Offin River	7½	3	4½
Ribon Valley	16½	15½	—
South Bukeru Areas	—	—	—
Tin Fields	—	—	—
Tin Properties	6	6	6
United Tin Areas	27	28	—
Yarde Kerri	9	12	15

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	August.	Sept.	Oct.
Anglo-Burma (Burma)	39½	37	38⅛
Aramayo Mines (Bolivia)	203	208	171
Bangrin (Siam)	84	107	96½
Berenguela (Bolivia)	—	—	—
Consolidated Tin Mines (Burma)	200	176	130
East Pool (Cornwall)	83	82⅛	—
Fabulosa (Bolivia)	137	130	181
Geevor (Cornwall)	41	32	45
Jantar (Cornwall)	22½	22⅛	—
Kagera (Uganda)	28	28	28
Northern Tavoy	—	—	—
Patino	1,329	1,309	—
Polhigey (Cornwall)	30	25	18½
San Finx (Spain)	30½*	32½*	—
Siamese Tin (Siam)	149	—	—
South Croftv (Cornwall)	65½	63⅛	65
Tavoy Tin (Burma)	—	—	64
Theindaw (Burma)	—	—	—
Tongkah Harbour (Siam)	89	90	93
Toyo (Japan)	46	59½	60½
Wheal Kitty (Cornwall)	40	38	—
Zaaiplaats	30	30	—

* Tin and Wolfram.

COPPER, LEAD, AND ZINC OUTPUTS.

		Sept.	Oct.
Broken Hill South	Tons lead conc.	5,958	6,076
	Tons zinc conc.	—	—
Burma Corporation	Tons refined lead	6,420	6,420
	Oz. refined silver	540,000	560,000
Bwana M'Kubwa	Tons copper oxide	690	651
Electrolytic Zinc	Tons zinc	4,135†	4,210*
Indian Copper	Tons copper	234	298
Messina	Tons copper	736	697
Mount Lyell	Tons concentrates	3,766†	—
Namaqua	Tons copper	—	—
North Broken Hill	Tons lead conc.	5,650	5,770
	Tons zinc conc.	—	—
Poderosa	Tons copper ore	588	686
Rhodesia Broken Hill	Tons lead	—	—
	Tons slab zinc	1,438	1,360
San Francisco Mexico	Tons lead conc.	3,874	4,429
	Tons zinc conc.	2,669	4,242
Sulphide Corporation	Tons lead conc.	2,127	2,035§
	Tons zinc conc.	2,841	2,789§
Tetiuhe	Tons lead conc.	1,094	1,241
	Tons zinc conc.	2,646	2,523
Union Minière	Tons copper	—	—
Zinc Corporation	Tons lead conc.	5,932	—
	Tons zinc conc.	3,192	—

‡ Four weeks to Sept. 17. † Four weeks to Oct. 8.
* Four weeks to Oct. 15. § Four weeks to Oct. 18.

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

		August.	Sept.
Iron Ore	Tons	227,070	227,557
Manganese Ore	Tons	22,976	7,377
Iron and Steel	Tons	195,404	223,829
Copper and Iron Pyrites	Tons	18,483	14,949
Copper Ore, Matte, and Prec.	Tons	3,217	3,227
Copper Metal	Tons	15,040	16,429
Tin Concentrate	Tons	6,185	5,196
Tin Metal	Tons	723	720
Lead Pig and Sheet	Tons	22,574	32,348
Zinc (Spelter)	Tons	11,776	7,353
Zinc Sheets, etc.	Tons	2,257	2,078
Aluminium	Tons	1,518	898
Mercury	Lb.	116,221	189,755
Zinc Oxide	Tons	672	947
White Lead	Cwt.	11,928	12,163
Red and Orange Lead	Cwt.	3,625	4,415
Barytes, ground	Cwt.	45,854	39,088
Asbestos	Tons	2,388	1,885
Boron Minerals	Tons	194	594
Borax	Cwt.	22,956	9,800
Basic Slag	Tons	995	2,843
Superphosphates	Tons	2,318	2,123
Phosphate of Lime	Tons	33,082	26,658
Mica	Tons	289	214
Sulphur	Tons	5,593	220
Nitrate of Soda	Cwt.	24,403	46,207
Potash Salts	Cwt.	456,965	385,312
Petroleum : Crude	Gallons	37,595,990	42,392,357
Lamp Oil	Gallons	18,632,997	26,615,101
Motor Spirit	Gallons	76,415,615	69,103,989
Lubricating Oil	Gallons	8,428,060	8,147,700
Gas Oil	Gallons	10,531,274	12,797,796
Fuel Oil	Gallons	32,471,441	47,944,158
Asphalt and Bitumen	Tons	15,389	18,355
Paraffin Wax	Cwt.	147,206	127,921
Turpentine	Cwt.	73,639	98,859

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES.

In Tons.

	August.	September.	October.
Anglo-Ecuardorian	17,017	15,752	16,362
Apex Trinidad	39,500	40,430	41,820
Attock	2,286	1,936	1,805
British Burmah	4,986	4,589	4,667
British Controlled	33,121	30,588	35,814
Kern Mex.	752	784	861
Kern River (Cal.)	2,503	2,696	2,732
Kern Romana	2,420	2,467	2,241
Kern Trinidad	4,824	4,152	3,836
Lobitos	29,214	28,501	29,257
Phœnix	40,445	51,890	37,527
St. Helen's Petroleum	5,968	5,696	6,251
Steaua Romana	64,060	60,100	50,550
Tampico	3,053	3,041	3,137
Trinidad Leaseholds	28,400	28,500	26,350
Venezuelan Consolidated	—	—	—

QUOTATIONS OF OIL COMPANIES' SHARES.

Denomination of Shares £1 unless otherwise noted.

	Oct. 10, 1930.			Nov. 10, 1930.		
	£	s.	d.	£	s.	d.
Anglo-Ecuadorian		12	3		11	6
Anglo-Egyptian B.	2	1	3	1	17	6
Anglo-Persian 1st Pref.	1	7	6	1	8	9
,, ,, Ord.	3	3	0	2	18	9
Apex Trinidad (5s.)		13	9		12	6
Attock	1	3	0	1	0	0
British Burmah (8s.)		4	0		4	3
British Controlled ($5)		1	6		1	3
Burmah Oil	3	18	0	3	16	3
Kern River Cal. (10s.)		2	9		3	3
Lobitos, Peru	1	8	0	1	5	0
Mexican Eagle, Ord. (4 pesos)		9	0		7	9
,, ,, 8% Pref. (4 pesos)		8	9		7	9
Phœnix, Roumanian		7	9		7	6
Royal Dutch (100 fl.)	27	12	6	26	0	0
Shell Transport, Ord.	4	1	3	3	16	3
,, ,, 5% Pref. (£10)	9	17	6	10	1	3
Steaua Romana		6	0		5	9
Trinidad Leaseholds	1	1	3	1	1	3
United British of Trinidad (6s. 8d.)		4	6		5	0
V.O.C. Holding	1	13	0	1	11	3

PRICES OF CHEMICALS. Nov. 8.

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

		£	s.	d.
Acetic Acid, 40%	per cwt.		16	6
,, 80%	,,	1	16	3
,, Glacial	per ton	58	0	0
Alum	,,	8	10	0
Alumina, Sulphate, 17 to 18%	,,	6	15	0
Ammonia, Anhydrous	per lb.			10
,, 0·880 solution	per ton	15	10	0
,, Carbonate	,,	27	10	0
,, Nitrate	,,	16	0	0
,, Phosphate	,,	40	0	0
,, Sulphate, 20·6% N.	,,	9	3	0
Antimony, Tartar Emetic	per lb.			11
,, Sulphide, Golden	,,			7
Arsenic, White	per ton	18	15	0
Barium, Carbonate, 94%	,,	4	10	0
,, Chloride	,,	10	0	0
,, Sulphate, 94%	,,	5	0	0
Benzol, standard motor	per gal.		1	5
Bleaching Powder, 35% Cl.	per ton	6	15	0
Borax	,,	13	10	0
Boric Acid	,,	22	0	0
Calcium Chloride	,,	5	5	0
Carbolic Acid, crude 60%	per gal.		1	8
,, ,, crystallized, 40°	per lb.			5½
Carbon Disulphide	per ton	15	0	0
Citric Acid	per lb.		1	5½
Copper Sulphate	per ton	21	0	0
Cresylic Acid, 97–99%	per gal.		1	10
Creosote Oil (f.o.b. in Bulk)	,,			4½
Hydrofluoric Acid	per lb.			6
Iodine	per oz.		1	0
Iron, Nitrate 80° Tw.	per ton	6	0	0
,, Sulphate	,,	2	0	0
Lead, Acetate, white	,,	35	10	0
,, Nitrate	,,	29	10	0
,, Oxide, Litharge	,,	31	10	0
,, White	,,	41	0	0
Lime, Acetate, brown	,,	7	5	0
,, ,, grey, 80%	,,	14	0	0
Magnesite, Calcined	,,	9	10	0
Magnesium, Chloride	,,	6	15	0
,, Sulphate, comml.	,,	3	15	0
Methylated Spirit 64° Industrial	per gal.		1	9
Nitric Acid, 80° Tw.	per ton	21	0	0
Oxalic Acid	per cwt.	1	12	0
Phosphoric Acid	per ton	29	15	0
Pine Oil	,,	42	10	0
Potassium Bichromate	per lb.			4½
,, Carbonate	per ton	24	10	0
,, Chlorate	,,	24	10	0
,, Chloride 80%	,,	9	15	0
,, Ethyl Xanthate	per 1,016 kilos	55	15	0
,, Hydrate (Caustic) 90%	per ton	28	10	0
,, Nitrate, refined	,,	19	17	6
,, Permanganate	per lb.			5¾
,, Prussiate, Yellow	,,			6½
,, ,, Red	,,		1	8
,, Sulphate, 90%	per ton	11	0	0
Sodium Acetate	,,	18	5	0
,, Arsenate, 45%	,,	20	10	0
,, Bicarbonate	,,	10	10	0
,, Bichromate	per lb.			3¾
,, Carbonate (Soda Ash)	per ton	6	0	0
,, ,, (Crystals)	,,	5	5	0
,, Chlorate	,,	23	0	0
,, Cyanide 100% NaCN basis	per lb			7
,, Ethyl Xanthate	per 1,016 kilos	53	5	0
,, Hydrate, 76%	per ton	14	10	0
,, Hyposulphite	,,	9	0	0
,, Nitrate (ordinary)	,,	9	12	0
,, Phosphate, comml.	per cwt.		10	0
,, Prussiate	per lb.			4¾
,, Silicate	per ton	9	10	0
,, ,, (liquid, 140° Tw.)	,,	8	10	0
,, Sulphate (Glauber's Salt)	,,	2	2	6
,, ,, (Salt-Cake)	,,	2	15	0
,, Sulphide Conc., 60/65%	,,	8	10	0
,, Sulphite, pure	per cwt.		14	0
Sulphur, Flowers	per ton	11	0	0
,, Roll	,,	9	10	0
Sulphuric Acid, 168° Tw.	,,	4	16	6
,, ,, free from Arsenic, 144° Tw.	,,	4	0	0
Superphosphate of Lime, 35%	,,	3	1	3
Tartaric Acid	per lb.		1	0½
Turpentine	per ton	38	0	0
Tin Crystals	per lb.			11¾
Titanous Chloride	,,			10
Zinc Chloride	per ton	9	10	0
Zinc Dust	,,	20	0	0
Zinc Oxide	,,	39	0	0
Zinc Sulphate	,,	9	0	0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

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

COPPER:		
Bwana M'Kubwa (5s.) Rhodesia	8 9	8 9
Esperanza Copper, Spain	1 1 6	1 1 6
Indian (2s.)	1 3	1 3
Loangwa (5s.), Rhodesia	2 3	2 6
Luiri (5s.), Rhodesia	3 6	3 3
Messina (5s.), Transvaal	7 6	8 6
Mount Lyell, Tasmania	16 3	19 0
Namaqua (£2), Cape Province	7 6	7 6
N'Changa, Rhodesia	2 7 6	2 0 0
Rhodesia-Katanga	18 9	17 6
Rio Tinto (£5), Spain	30 5 0	30 0 0
Roan Antelope (5s.), Rhodesia	16 3	17 0
Tanganyika, Congo and Rhodesia	1 8 9	1 5 9
Tharsis (£2), Spain	3 11 3	3 10 0

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

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

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

NOTES ON VENTILATION PROBLEMS

A paper entitled "New Lines of Thought on Ventilation", by R. A. H. Flugge-de Smidt, appeared in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa for August. This paper, full extracts from which are given here, indicates widely held views on ventilation which, in the opinion of the author, are most open to criticism. A paper by the same author on the computation of fan efficency, was extracted in these columns in the June issue.

VENA CONTRACTA IN AN ORIFICE.—The illustration Fig. 1 depicts the stream lines of a quantity of air passing through an orifice regulator. The pull towards the orifice is equal along all points on the dotted semi-circle. The result is a crowding of the stream lines near the edge of the orifice—the

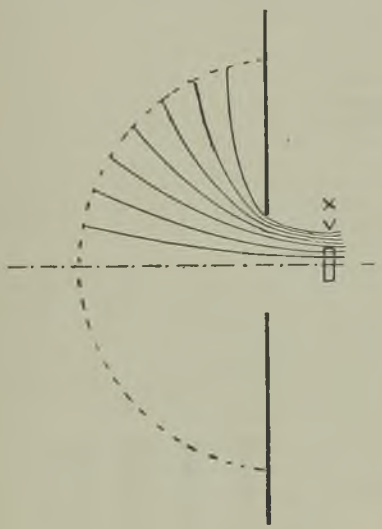


FIG. 1.

same volumes have to pass through a smaller space, so that the velocities are much higher around the edge than in the centre of the orifice. When measuring quantities passing through a regulator, the anemometer is held in the orifice. Instead of making a considerable reduction for vena contracta, as most authorities hold, the writer contends that the reading obtained in a central position is often less than the average velocity through the regulator.

If one held the anemometer some distance beyond the opening, as at ×, then a considerable reduction would have to be made. Using a 4 in. anemometer at the intake of 22½ in. piping the following results were obtained:—

Velocity at centre, 410 f.m.
Velocity at edge, 470 f.m.

In the case of an orifice regulator the maximum vena contracta effect is obtained when the edge of the orifice is at least three times the diameter of the orifice away from the edge of the duct on all sides.

A considerable amount of research work is called for to standardize the methods of measuring air at regulators and at intakes to piping.

REGULATORS.—The usual regulator consists of an aperture in a brattice. Air issuing through such a regulator generally attains a high speed. A considerable amount of power is destroyed in eddying. The author conceived the idea of constructing regulators with a venturi shape, so that most of the velocity pressure should be converted into static pressure and a minimum of power destroyed. Lack of facilities for experimental work has prevented him from proving the point, but imagine an extreme case where air in passing from shaft to shaft can travel by a large number of paths and where it is necessary to regulate the air in all but one. (Fig. 2.) There are n paths numbered X_1, X_2, X_3, ... X_n; X_n is taken to

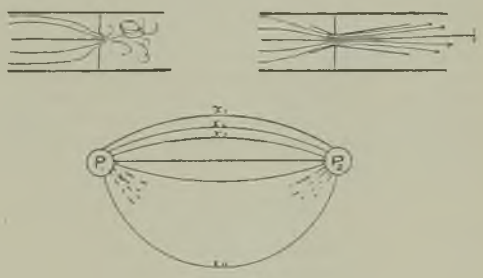


FIG. 2.

be the longest path and all the others are regulated by orifice regulators. In every path from X to X_{n-1} power is destroyed, so that the cumulative effect is great. The result would be to minimise the total volume circulating.

The author contends that if all the orifice regulators were replaced by venturi regulators less power would be destroyed and a greater total volume would circulate, provided the drop in pressure between P_1 and P_2 remained the same in each case.

INTAKES TO HIGH PRESSURE FANS.—Using a pitōt-tube at the intake to a centrifugal fan, the writer measured a velocity at the centre of 1,000 f.m. while the velocity at the edge was no less than 6,000 f.m. The excessive velocity near the edge means a considerable loss of power. In an ideal intake the velocity should be uniform over the whole area.

The illustration, Fig. 3, is an attempt to design an ideal intake for such a fan. Improvement shown on upper half only. The shaded portions should be filled in as they represent useless spaces.

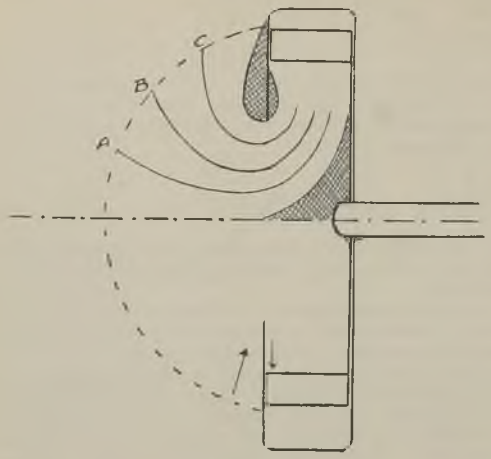


Fig. 3.

A, B, and C represent guide vanes so constructed that the air is conducted with a uniformly increasing velocity in each channel and into the required final direction.

In practice it would be difficult to conform to such an ideally shaped inlet, but the writer is convinced that any advance along these lines would lead to an increased efficiency.

Propeller Fans.—A propeller blade mounted on a revolving shaft has a very great tip velocity and can impart this or an even greater velocity to the air. The velocity that can be imparted to the air rapidly diminishes from the tip towards the shaft, until near the shaft it is almost negligible (Fig. 4). Such a propeller operating against little resistance, as for instance a fan in a wall of a building, can successfully propel air over its entire length. When, however, such a fan is harnessed to a considerable resistance the position is entirely changed (Fig. 5). The velocity imparted to the air has to be converted into static pressure. The pressure produced by the tips is very much greater than that produced near the shaft, consequently there is a natural tendency for the air to flow from the region of high pressure to the region of low pressure resulting in a reversal of flow near the shaft.

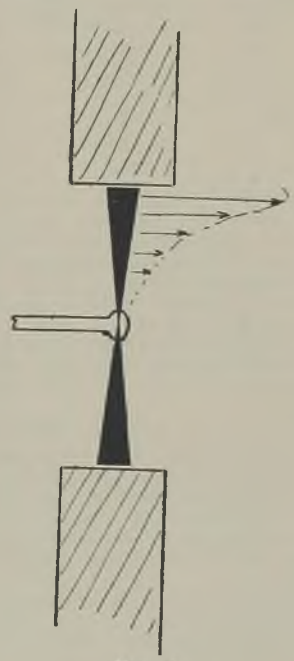


Fig. 4.

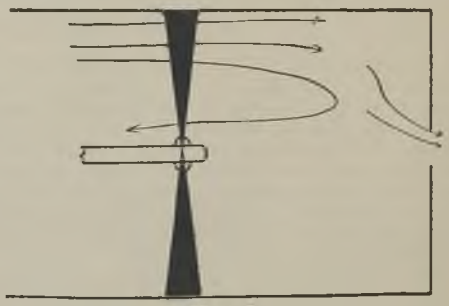


Fig. 5.

With a number of blades mounted on one shaft the position is the same (Fig. 6).

It is useless to mount a smaller propeller in front on the same shaft where all the relative velocities remain the same. In every fan the blades impart velocity to the air and the velocity pressure is then converted into static pressure. Propeller fans are usually placed in a drift of uniform cross-sectional area. As the air approaches the blades its velocity increases, therefore the cross-sectional area must be decreased if the air is to fill the duct. With propeller blades the only reasonable way to reduce the cross-sectional area is to fill in the useless centre space around the shaft. Fig. 7 illustrates the author's idea.

Commencing with a bold round boss increasing in diameter with each successive set of blades then tapering off gradually to a fine point. The pitch and width of each successive set of blades to be determined by the increasing velocity to be imparted to the air. The author feels confident that a fan on these lines would be capable of building up pressure to almost any extent.

Fig. 6.

In a modified form these ideas for improving propeller fans were contained in a report presented to the Chamber of Mines by the author some years ago ; while the whole matter was propounded very fully in lectures by the author to Dust Inspectors in 1927. It is necessary to mention this because C. W. B. Jeppe in a paper entitled "Studies in Ventilation at the Crown Mines, Witwatersrand," and read before the Institution of Mining and Metallurgy in November, 1929, says :—"Re-entry of air is, in general, considerable : it may be minimized by placing a small pilot propeller at the

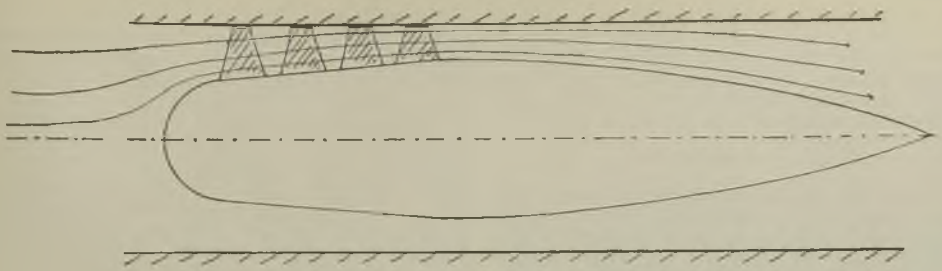


FIG. 7.

end of the shafting and also probably by shaping the shafting : *e.g.*, a cigar-shaped shaft with small blades."

The author does not desire to criticise propeller fans built up out of aeroplane propeller blades but rather to suggest development on different lines.

FAN EVASÉES.—It has been shown by Briggs and others that an ideal evasée is one that expands at 3½° on all sides. An evasée should continue expanding until the velocity pressure of the discharge is so small as to be negligible. An ideal evasée for a mine fan would often reach such proportions that the expense would make it prohibitive. If any jet of air can be expanded at 3½° the idea occurred to the author that the discharge of a fan could be split up into a number of channels and each channel expanded at 3½°. Should this be feasible, then a given discharge could be reduced to a reasonable velocity in a very much shorter length.

For instance, an ideal evasée for a fan discharge of 6 ft. by 6 ft. and a velocity of 4,000 f.m. would have a length of 49 ft. and a final velocity of 1,000 f.m. The same final velocity could be achieved by having an evasée divided into 4 sections each of which would be expanded at 3½° on all sides and having a length of only 24½ ft.

In order to test the idea an arrangement as shown in Fig. 8 was used, where *a* represents a fan in a 22½ ft. duct, *b* denotes a resistance on the intake side which consisted of 300 ft. of piping and many bends, *c* is a German standard nozzle, and *d* is a water-gauge.

The German standard nozzle ensures that the air issuing from it has a uniform velocity over the whole outlet. The outlet in this instance had a diameter of 9 in.

Case I. as in Fig. 8 I. Nozzle only. W.G. registered 2 in. Vol. discharged 2,833 c.f.m.

Case II. A single cone expanded from 9 in. to 18 in. diameter at 15° attached to nozzle. W.G. dropped to 1⅜ in. Volume discharged not measured but > 2,833 c.f.m.

Case III. Same cone as in Case II. divided up into a number of cones the expansion in each division being 3½°. W.G. dropped to 1 in. Volume discharged = 4,090 c.f.m.

Case IV. One simple cone expanded at 3½° from 9 in. to 18 in. diameter. W.G. dropped to ¼ in. Volume discharged = 4,520 c.f.m.

These comparisons give perhaps only indications but the following deductions appear justified.

(1) Any evasée is better than none.

(2) A too wide-angled evasée can be greatly improved by dividing it up into sections.

(3) The best evasée is a very long slender one.

SUGGESTED ALTERATION TO THE BASIC FORMULA OF VENTILATION.—From time to time the original formula put forward by J. J. Atkinson, namely :— $P = \frac{K S V^2}{A}$ has been subjected to revision. The factor K. and the power 2 of V. have been the points of attack.

Briggs sums up the position to date by saying that the formula "has emerged from recent and rigorous criticism with flying colours, because it is sufficiently close to the truth for practical purposes." To tackle this formula again, although from an entirely different angle, would appear to be the height of folly. A glance at it shows that it is entirely concerned with frictional resistance and that P is the power required to overcome that resistance. As V denotes, we are referring to moving air and the power that is required to keep that air moving has been entirely ignored. The writer puts forward a comprehensive formula to include velocity pressure.

The total power imparted to the air to cause it to circulate is the power necessary to overcome frictional resistance + velocity pressure. The formula should read :—

$$P = \frac{K S V^2}{A} + \frac{w \cdot v^2}{2g}, \text{ where}$$

P = Pressure in lbs. per sq. ft.
Let V = velocity in 1,000 ft. per minute
and K = coefficient of friction corresponding to above.
v = velocity in ft. per second.
w = density of air.
g = acceleration due to gravity.

Converting v into terms of V, we have :—

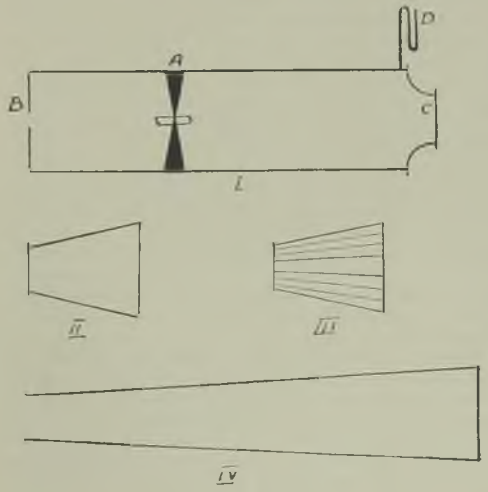


FIG. 8.

$$P = \frac{K\,S\,V^2}{A} + V^2\left(\frac{138{\cdot}3w}{g}\right)$$

Assuming values $w = 0{\cdot}075$ lbs. f^3
and $g = 32$ f.s.^{2}
the formula is simplified to :—

$$P = \frac{K\,S\,V^2}{A} = 0{\cdot}3242\ V^2$$

As a practical application the writer would like to draw attention to the absurdity of one of the so-called laws of splits that is contained in practically all text-books on ventilation. It is generally stated in this form that, all other conditions being equal, the quantities passing through 2 or any number of splits vary inversely as the square root of the lengths of the splits. Take a practical example and work it out both ways :—

2 Splits $L_1 = 1000'$ $L_2 = 4000'$
$K = 0\ 001$ $A = 10$ ft. $\times$ 10 ft. for both splits.
$P = 2$ in. W.G.

The text-book and examination question answer would be

$$V_1 : V_2 : : 2 : 1$$

Using the formula $P = \frac{K\,S\,V^2}{A} + 0\ 3242\ V^2$ we obtain $V_1 = (90)$ 3,790 f.m.
and $V_2 = (2{,}325$ f.m.) 2,325 f.m. This shows up an error of 17 2% in what might be termed a reasonable, practical problem. If $L_1 = 100'$ and $L_2 = 400$ the hitherto accepted solution would be wrong by no less than 73·5%.

In calculating the power required to pull air through a shaft the velocity pressure cannot be ignored and many other practical instances could be quoted. The formula suggested by the author conforms to the equation—Total pressure = static pressure + velocity pressure.

NATIVE SULPHUR

The occurrence, exploitation and uses of native sulphur form the subject matter of Information Circular 6329 of the United States Bureau of Mines, extracts from which are given here.

Occurrence.—Sulphur is abundantly distributed in nature in both the combined and the free state. Hundreds of minerals contain sulphur as one of their essential chemical constituents, but only a few are mined or used for sulphur, and of these few only native sulphur is used exclusively for its sulphur. In its native state sulphur occurs in a pure crystalline form, commonly intermixed with earthy matter, this being the most important source of all native sulphur.

With regard to origin, native sulphur has two types of occurrence. Large deposits occur in sedimentary rocks and are generally the result of the reduction of gypsum. The enormous deposits of the Gulf Coast region of the United States and the deposits of Sicily are of this type. The sulphur of the Gulf Coast region is found associated with salt dome intrusions which show many unusual features. It is probable that these domes are Permian or Carboniferous salt beds forced up through the softer sediments. The forces which caused the intrusion have been variously attributed to deposition from solution with lifting power due to crystallization and to the pressure flowage of the plastic salt. The latter theory seems to be most favoured. The sulphur occurs in the limestone, gypsum, and anhydrite cap-rock which forms a mantle over the salt plug intrusion. There are many of these domes in the Gulf Coast region of the States of Texas and Louisiana, but only a very few contain sulphur in commercial quantities.

Sulphur is also commonly found in the rocks of volcanic vents, or of solfataras. Hydrogen sulphide (H_2S) is a common exhalation from volcanoes, and the reduction of this gas gives volcanic sulphur which is deposited in the tufas or other adjoining porous rock.

World Sources.—The principal sources of sulphur in the world to-day are the United States, Italy, and Japan, with the first by far the most important. Other countries producing sulphur, but of minor importance, are Chile, Spain, and the United Kingdom (as a by-product of the Chance-Claus process and in the purification of coal gas). Other sources of known production are Austria, Ecuador, France, Greece, China, Mexico, New Zealand, and Russia. For many years past and until 1903, 95% of the world's supply of sulphur was mined and prepared for use in Sicily. Since then, however, the United States has become the largest producer, contributing about 80% of the world's sulphur in 1929.

Mining Methods.—(*a*) *United States*.—The method of winning sulphur employed by the Texas Gulf Company is typical of those used in the district. The sulphur is mined by a variation of the Frasch process, the basic principle of which is the injection of large volumes of superheated water into the formations for the liquefaction of sulphur; this permits the pumping of liquid sulphur to the surface. The process was developed by Dr. Frasch from 1890 to 1903 on a similar deposit in Calcasieu Parish, La., which ceased to operate, due to exhaustion, in December, 1924, after producing some 10,000,000 tons of sulphur.

Ordinary oil-well equipment is used to bore holes to the bottom of the sulphur-bearing strata. Concentric pipes varying in size from 10 in. to 1 in. are placed in the holes. A 10 in. or an 8 in. casing extends to and rests upon the cap rock. Inside this casing a pipe of smaller diameter passes below the lower end of the casing, through the sulphur-bearing stratum, and rests in the upper portion of the barren anhydrite. A still smaller pipe passes through the second so that an annular space exists between the two; it extends nearly to the bottom of the sulphur-bearing rock and rests on a collar which seals the annular space between the second and third pipes. Finally, a 1 in. air pipe, inside all the others, extends to a depth slightly above the collar mentioned above. The second pipe is perforated at two different levels, one above and the other below the annular collar. The upper set of perforations permit escape of the hot water while the molten sulphur enters the system through the lower perforations.

For operation of the well, hot water is passed down the annular space between the second and third pipes. It discharges through the perforations into the porous formation near the foot of the well. The region about the well through which this water circulates is raised to a temperature above the melting point of sulphur. Molten sulphur, being heavier than the water, makes its way downward

to form a pool around the base of the well where it enters through the lower perforations and rises in the space between the third and fourth pipes. The height to which the sulphur rises between the pipes is a consequence of its specific gravity and the pressure in the porous formation established by the force of the water produced by the pumps in the power plant and required to secure its entrance into the deposit. The height may be one-half or two-thirds of the depth of the well. Compressed air, released at the bottom of the central 1 in. pipe, rises and mixes in the sulphur column, the weight of which is reduced by aerification, thus producing an air lift that raises the sulphur to the surface. At the surface the sulphur from the wells is collected in heated sumps at pumping stations from which it is pumped through well-insulated pipes into large wooden vats. The wooden vat walls are built up slowly and are kept only a few inches higher than the sulphur. When the vat is complete the wooden walls are removed. The sulphur is in a solid state and requires no support. The vats vary in size and are as much as 800 ft. long, 200 ft. wide, and 50 ft. high. They often contain over half a million tons. The block of sulphur is drilled, broken down by blasting, and loaded into cars by a locomotive crane. Shipments to the Gulf Coast are made in open cars whereas shipments inland are made in box cars. Box cars must be used behind coal-burning locomotives because of the fire hazard.

(*b*) *Sicily*.—The sulphur of Sicily is found chiefly in an argillaceous limestone associated with gypsum and bituminous marl. Its structure is coarsely crystalline but usually compact. The sulphur-bearing rocks occur in the form of immense lenses rather than as extensive beds. The lenses are of variable thickness and richness. Within the sulphur-bearing layer proper the sulphur occurs either in the form of irregular incrustations and small pockets, intimately mixed with limestone, or in thin bands (1 to 2 millimeters thick) interlaminated with country rock. The colour of the sulphur is usually brown or brownish gray, and occasionally is light yellow. The darker colour is usually due to the intimate mixture of bituminous substance. The minerals associated with the crystalline sulphur are chiefly celestite, aragonite, calcite, and gypsum. While most of the earlier theories laid unusual stress upon the direct influence of volcanism on the deposition of sulphur, it is now universally accepted that the sulphur is a result of the oxidation of H_2S, and this has caused the theory of bacterial reduction to be given serious consideration.

The methods of mining Sicilian sulphur are very simple. As the island is mountainous, tunnelling into the hillsides is common. Most of the ore, however, is mined through shafts, both inclined and vertical. Some properties have modern hoisting machinery and trams. In others steps are hewn in the rock of the shaft and the sulphur ore is carried to the surface in baskets. Until declared illegal, a large number of boys were used in most of the smaller mines to carry the sulphur to the surface. Explosives are used in many of the mines, but the utmost caution must be taken to prevent fire. Timber supports are never used in these mines.

Sulphur is extracted from the ore by (1) burning part of the sulphur in mounds called calcaroni (2) by burning part of the sulphur in Gill regenerative kilns (3) and by means of retorts heated with superheated steam.

In the calcaroni system sulphur ore containing not less than 15% sulphur is built into a mound, 9 ft. high, over a circular floor about 60 ft. in diameter. The ore is covered with fine residue material from a previous mound. Fuel is used to start combustion, but the sulphur is melted partly by the heat of its own burning. Beneath the heap, the sloping floor has compartments in which the fused sulphur collects and solidifies into bricks weighing about 100 lb. each. A recovery of about 60% is possible, but the escaping sulphurous gases cause destruction to the vegetation in the district. In 1927, 61% of the sulphur produced in Italy was won from the ores by the Gill furnace, 30% by the Calcaroni process and 8% by steam recovery methods.

The sulphur as first obtained by simple melting out from the ore is far from pure and quite useless for many purposes, but most of the impurities, amounting to 3 or 4%, may be removed by distillation or sublimation.

Sicily has extensive ore reserves, and with the use of improved mining methods and modern mining machinery its costs should be materially lowered. Lower royalties and the consolidation of the smaller properties may effect further economies so that in the future the production from Sicily is likely to increase.

Production.—The world production of sulphur in 1929 was 2,770,000 tons, of which the United States contributed 2,360,000 tons and Italy 323,000 tons, and the known reserves of both countries are ample for many years at this rate of output. A single dome in Texas, that of Union Sulphur Co., yielded 10,000,000 tons before exhaustion. The Big Hill dome of Texas Sulphur Co. gave 7,000,000 tons to the end of 1928 and still is yielding over 1,000,000 tons annually. The Bryan mound of Freeport Sulphur Co. has produced 4,000,000 tons to date and its present output is 1,000 tons a day. The Hoskins mound of the same company has an output of 1,000 to 1,500 tons a day and a drilled reserve of 11,000,000 tons.

Uses.—The uses of sulphur are innumerable. The most important is the manufacture of sulphuric acid, the basis of a large part of the chemical industry. Next comes its use in making pulp and paper. It is also used extensively as a fungicide and insecticide. The refining of petroleum and the rubber industry consume substantial quantities.

Marketing and Price.—Sulphur comes into commerce in several forms such as crude, flour, refined, flowers of sulphur, and precipitated or milk of sulphur. The crude sulphur produced in the United States is the regular run-of-mine sulphur and is guaranteed to contain 99·5% of pure sulphur and often contains as high as 99·9%. The primary marketing points for crude sulphur are the mines from which shipments are made direct to consumers in any quantity.

Commercial flour sulphur is the crude sulphur that has been ground and sized. It is often subsequently graded and marketed according to certain specifications. It is usually shipped in burlap sacks containing about 100 lb. net. This product is used extensively as a fungicide or insecticide and in the manufacture of rubber.

Refined sulphur is made by distilling and condensing crude sulphur. Often the sulphur is caught in a small hot receptacle in the molten

state, cast into sticks and sold as roll sulphur. Roll sulphur is shipped in barrels or bags and is used largely as a fumigant. Refined sulphur is also ground and marketed in 100 lb. bags for certain uses.

Flowers of sulphur is sublimed sulphur which is caught in dust form. Flowers of sulphur are usually marketed in 100 lb. bags and is used largely for medicinal purposes; it is preferred in some countries for dusting grape vines.

Milk of sulphur or precipitated sulphur is the white or gray amorphous sulphur deposited by the decomposition of an aqueous solution of calcium polysulphide (obtained from flowers of sulphur and lime). Milk of sulphur is used largely for medicinal purposes.

SWEDISH GEO-ELECTRICAL PROSPECTING METHODS

(*Concluded from the October issue, p.* 245)

Description of Geo-electrical Surveys of Ore-Fields.

Skellefte District, Northern Sweden.—The geo-electrical investigation of the Skellefte district began in 1918, and is the largest geo-electrical investigation hitherto carried out in an ore-district. Over twenty ore-fields, with about 50 ore-bodies have been found by investigating over 400 km.^{2} of the ore-bearing formation, which consists of metamorphic volcanics overlain by graphitic slate. The ore-bodies are lenticular and of various sizes up to 600 m. in length and 80 m. in width. The ore is highly conductive and consists of pyrite, pyrrhotite, arsenopyrite, chalcopyrite, blende, etc., sometimes with high gold and silver values. Barren electrical indications are caused by layers of graphitic slate and lean disseminations of pyrite and pyrrhotite. Magnetic and gravimetric methods have been employed to distinguish between valuable and barren indications before drilling. The bed-rock is covered by moraine, peat-bogs, and lakes to such an extent that a direct prospecting of the ore-bodies by investigating the outcrops is rendered impossible. Detailed geological mapping is also impossible and in fact a large part of the geo-electrical and magnetical work has been executed in order to obtain a geological map of the bed-rock.

This geophysical mapping of the bed-rock has made it possible to work out the structure of the ore-bearing formation, which will be of great value for mining operations, not to speak of the scientific value. Electrical as well as seismic methods have been used to determine the depth of the covering moraine, peat and water.

The most important discoveries in the Skellefte district are:

Boliden.—Discovered in 1924 by the inductive method. Depth to bed-rock 7–19 m. A lens of pyritic copper-gold-arsenic ore 600 m. long and up to 30 m. wide.

Asen-Kedtrask.—A number of long, straight lenses of pyrite and copper ore under heavy cover.

Bjurfors.—Discovered in 1922 by means of the equipotential method. Depth to bed-rock 5–18 m. (sand and moraine). A lens 15 × 180 m. of rich copper ore. Other lenses with pyrite and zinc ore.

Menstrask.—A number of ore-bodies with pyrite, copper and zinc ore, discovered by inductive methods. Most of the ore-bodies are situated under the lake Menstrasket.

Rakkejaur and Näsliden.—Some very large lenses of pyrite ore, also minor lenses of copper-arsenic-gold ore at Rakkejaur. Located by inductive and electromagnetic methods. Partly situated under peat-bogs.

Kristineberg.—The first discovery of ore of any importance made in the Skellefte district. Located by the equipotential method 1918. A number of elongated ore-bodies with pyrite and chalcopyrite.

Investigations in the Caledonian folding zone of Sweden and Norway.—In the Caledonian folding zone of the mountain region of the Scandinavian peninsula geo-electrical investigations have been carried out at Björkåsen and Lökken, Norway, and in the Tärna and Vilhelmina districts of Sweden. The ore-bodies are always pyritic and good conductors, but mostly accompanied by graphitic slates and lean, or narrow, valueless bands of pyrite and pyrrhotite, causing much trouble when being investigated. Some use has been made of these valueless conductors to work out the structure of the ore-districts, but not to such a large extent as in the Skellefte district. The ore-bodies are often much folded, with low-pitching, folding axes, causing irregular outcrops and indications. Outcrops are plentiful and as most of the work has been carried out in old mining districts, not so many ore-bodies have been discovered as in the Skellefte district.

The best results have been obtained in the newly discovered districts in Sweden, where some ore-bodies have been located and at the Björkåsen mine in Norway, where the course of the ore-bearing graphite-slate zone has been followed in detail.

Central and Southern Sweden.—Electrical investigations have been carried out on a number of ore-deposits in the old mining districts of central and southern Sweden. As most ore-bodies were already located long ago (to a great extent by magnetic methods) there were no such successes as in the Skellefte district. Nevertheless many occasions have occurred on which to check the accuracy of the geo-electrical methods on known ore-bodies. These are all situated within the metamorphic Archean formation. They are formed as bands or lenses, mostly steep-dipping. The type of the ore varies very much in the different ore-fields. Some of the investigations are:

(a) *Surveys on iron ore-deposits.*—The purpose of these surveys is usually to ascertain if any non-magnetic bodies of specularite exist, which were not discovered by magnetic survey. On rich specularite distinct, but usually weak, indications have been obtained, but on lean specularite hardly any indications at all. An explanation of this fact may be the insulated position of the specularite grains within a quartz matrix. In this case the ore is as a rule not workable. The indications on magnetite-deposits are distinct, even on lean ore, sometimes also on disseminations without value. A survey on an earthy limonite ore originating from the leaching and oxidizing of a magnetite ore has given no indications except on parts of the ore-body containing residual magnetite or martite.

(b) *Surveys on sulphide deposits.*—On sulphide ore-bodies distinct indications have been obtained, except on those consisting of blende only. A number of barren indications have been obtained on accompanying disseminations of pyrite, pyrrhotite and magnetite. In the case of zinc and lead deposits the indications may be stronger than the ore indications. In some cases it has been possible to work out the general stucture of the ore districts or to follow up the whole strike on barren indications.

(c) *Surveys on quartz veins.*—Owing to the low sulphide content of all vein-formed ore-deposits investigated, no indications have been obtained.

Finland.—In Finland geo-electrical surveys by means of Swedish methods have been executed—in south-western Finland on sulphide deposits resembling the Swedish ones, and in eastern Finland on copper and pyrite deposits. Owing to a large number of graphitic layers accompanying the ore-bodies in eastern Finland, most of the indications are caused by such layers. In eastern Finland this has made possible the working out of an intricate overthrust folding structure in a heavy moraine-covered part of the Outokompu copper district. On the ore-bodies existing distinct indications have been obtained.

Central and South Europe.—According to the ancient history of mining most of the ore-bodies at or near the surface in central and southern Europe have been worked out. The possibility of discovering new ore-bodies is small. Surveys have been carried out: (1) on pyritic deposits in folded schists, (2) on zinc and lead deposits in limestone, and (3) on vein-form deposits.

On deposits of pyrite with copper and other metals good results have been obtained in Austria (Kallwang) and the Huelva district in Spain. In Kallwang it was possible also to work out the structure of the ore-field on accompanying graphitic slates. In Huelva barren indications were obtained on graphite, pyrite disseminations, and also on layers of banded jasper with much manganese.

In the copper district of Cyprus geo-electrical investigations have been greatly hampered by the great masses of highly conductive sulphate water, absorbed by porous sediments or clay.

Electrical investigations on low-temperature zinc and lead deposits in limestone have been less successful in Europe, as well as in other parts of the world. In the Sierra Lujar (Spain) and in Bleiberg the greatest difficulty has been caused by the mountainous character of the district, and the small size of the individual ore-bodies. The out-cropping ore-bodies have been mined out long ago and such as are still to be found exist deep in the mountains where they cannot be located from the surface, owing to their small size.

In western Galicia the ore is less conductive and indications are obtained on stagnant water in solution cavities of the limestone or on water which has been absorbed by clay.

On vein-form deposits distinct indications have been obtained on all important deposits investigated. On some veins with small amounts of conductive minerals no indications or only indistinct ones have been obtained.

South Africa.—The most important investigations in South Africa have been carried out in the copper districts of Namaqualand and North Rhodesia. In Namaqualand the ore-deposits consist of comparatively small lenses of bornite etc. spread over a large area. Some new lenses were located and as a rule no difficulties were met with.

In Northern Rhodesia an investigation was made at the N'Kana mine. The amount of sulphide is small and the deposit has been leached and oxidized to a comparatively great depth. The form of the ore-body is that of a gently folded layer. A distinct indication was obtained on the ore-body and also on parallel barren layers. When following the ore-body along the strike the survey lost the ore-body in a gap in the survey, and then never picked it up again owing to the small width of the area to be investigated.

Another investigation was carried out on nickeliferous pyrrhotite deposits of the Bushveldt norite intrusion. It showed the possibilities of locating such ore-bodies and also of working out the structure of the intrusion on conductive sulphide-bearing bands.

Billiton.—A most interesting investigation was carried out in the tin district of Billiton. It was possible—in most cases at least—to locate the tin bearing veins, owing to their sulphide and magnetite content, and also to some extent to work out the structure of the schists on conductive members.

Newfoundland.—Prospecting conditions in Newfoundland are very similar to those in the Skellefte district. The ore-bearing formation consists of altered volcanic rocks, folded along rather low-pitching fold axes. The ore-bodies are lenticular and consist of solid pyrite, galena, blende, chalcopyrite or pyrrhotite. The whole country has been glaciated. The bed-rock is now covered by moraine, sediments, peat and lakes, and seldom outcrops. The sulphides are never oxidized. The greatest discovery up to date was made at Buchan's Mine. Under a cover of moraine and peat two very large and some small ore-bodies containing millions of tons of pyritic galena-blende ore were discovered in 1925 by the equipotential method. Owing to the low pitch of the longer axis of the ore-bodies, it has been possible to trace them to some extent below the out-crop also. Outside Buchan's Mine some promising finds have been made, but the lack of good geological maps greatly hampers electrical investigation. Geological mapping is now carried on in connexion with electrical surveying, and some generally weak indications on pyritic disseminations have been of great assistance in combining the scarce exposures. Graphitic slates are also found within the district, but so far, not to any great extent within the areas hitherto surveyed.

The ore-bearing paleozoic folding zone on Newfoundland extends further south over Nova Scotia into U.S.A., with the same types of ore-deposits. Some successful geo-electrical surveys have been executed on a zinc-lead-copper deposit in Nova Scotia at Stirling, and on a pyrite deposit in Maine, U.S.A.

Precambrian Area of Canada.—In the Precambrian area of Canada larger areas have been surveyed geo-electrically at Rouyn, Quebec, and in Manitoba. The geo-electrical conditions are in both districts about the same as in the Skellefte district and Newfoundland, with sulphide lenses in altered volcanic rocks and the bed-rock covered by moraine, peat and lakes. In the Rouyn district large areas have been investigated geo-electrically and magnetically. A great many indications have been obtained but most of them are caused by barren pyrite disseminations. No real ore-body has so

far been found by electrical methods, but investigations on known ore-bodies have shown their suitability for electrical methods. A survey in order to outline an ore-body at Amulet was able to enlarge the tonnage already known. The sulphide deposition at Rouyn has begun with pyrite deposition on extensive shear zones. At a later date the valuable sulphides (chalcopyrite and blende) were deposited, but then only in restricted, favourable places within the shear-zones. The question is now how to recognize these places and when this geological question has been solved the extensive indications on pyrite-disseminations will be of great assistance as real guides to ore.

In Manitoba a survey was executed in order to determine the form and extent of some bodies of sulphide. Later trenching and drilling showed a good agreement with the boundaries electrically determined.

Some minor geo-electrical surveys on other types of ore-deposits belonging to the Precambrian have also been carried out with varied success.

Deposits of Native Copper in Michigan.—An experimental survey on the copper deposits of Michigan showed the possibility of locating at least the better copper lodes, despite the low content of conductive minerals. Indications were also obtained on bands of titano-magnetite, but these may be recognised by a magnetic survey of the electrical indications.

Sulphide Deposits within the Precambrian Areas of Western U.S.A.—Within the small areas of Precambrian not hidden by younger formations in the western states of America, some rather important sulphide deposits have been found. The sulphides are oxidized at the surface and the ground water is often rather conductive. Despite this a survey at the Pecos mine, N. Mexico, (pyritic zinc-lead ore) gave excellent results, even if the indications were somewhat weaker than on a similar un-oxided ore-deposit.

Ore-Deposits of Alaska, British Columbia, and Western U.S.A.—Some important geo-electrical surveys have been carried out on sulphide deposits of the North American Cordillera region, belonging to a rather deep-seated type of mesozoic age. At Beatson mine, La Touche Island, Alaska, a large lense of pyrite was located beneath a peat bog. At Kennecott, Alaska, prospecting conditions in the extremely rugged country were about the same as on the galena ores of Europe at Sierra Lujar and Bleiberg. At Anyox strong indications were obtained on pyrite disseminations and also on the ore-bodies known. At the Britannia mine B.C., it was possible by following the ore-zone in the strike, to locate a new ore-body geo-electrically. At Stemwinder, Kimberley, B.C. the known ore-body was outlined electrically and also a great many indications were obtained on barren disseminations of pyrite and pyrrhotite, showing the possibility not only to locate ore-bodies within this district, but also to work out the structure geo-electrically.

On the sulphide deposits in the Shasta County, California, the electrical conditions were about the same, except for the oxidation of the sulphides at the surface. A remarkable geo-electrical investigation was made on the molybdenum deposit at Questa, N. Mexico. Despite the small length of the veins, their low conductivity and the rugged country, some new veins were discovered. At Hanover, N. Mexico, an investigation was made on a contact-metasomatic zinc-lead deposit and new ore-bodies were located.

Zinc-Lead Deposits of the Mississippi Valley.—At an early date fairly large geo-electrical investigations were carried out on the lead-zinc deposits of the Mississippi Valley. The ore-bodies are situated in flat-lying limestone and are very irregular. They consist of galena, blende, pyrite and their oxidized products, and are mostly of low conductivity, only parts of the ore-bodies giving an electric indication. As such an indication could be used as the starting point for a drilling campaign, it was thought that electrical prospecting would be of value. Meanwhile, also, strong indications were obtained on the ground water and above all on clays, situated in solution depressions in the limestone surface. As was also the case in similar ore-deposits in Europe and Africa, this ore-type must be regarded as very difficult to locate by geo-electrical methods. Recent studies in Europe and America have shown that investigations of the structure may lead to discoveries of new deposits, and such studies, of course, may be made by geo-electrical methods.

Practical Results of Structural Work.—The earliest application of Swedish geo-electrical methods to structural work was made in Austria in 1925. Later surveys have been carried out in Poland, Roumania, Austria, Czechoslovakia, Germany, U.S.A. and Canada. The methods have been used to map salt domes, anticlines and domes and to trace faults.

Galicia.—The investigations in Poland were carried out at a very early stage in East Galicia and were not very successful, because at that time the influence of the surface beds was not taken into account. The surface beds in Galicia have often good conductivity and have of course nothing to do with the structure. At present corrections are always made for the surface-influence and it is felt that electrical structure-surveys would be useful for oil prospecting in Galicia, especially in the gently folded " Foreland."

Roumania.—A number of extensive surveys have been carried out in the outer zones of the Sub-Carpathians, but most of the work has been done under the stipulation that the results may not be published. A survey of the Boldesti anticline, however, found the structure to agree very well with the truth.

Vienna Basin.—Part of the geological depression known as the Vienna Basin is in Austria and part in Czechoslovakia. So far only the Czechoslovakian part is oil-productive. Electrical results obtained at the Lanzendorf and Schwadorf domes in Austria are found to agree with the geological observations.

Of results obtained in Czechoslovakia, a survey at Brodske, not far from the Gbely oil field, the original interpretation of the electrical results proved to be incorrect, because existing faults were not taken into consideration. By improving the technique, results consistent with the actual structure were obtained.

Germany.—Electrical surveys in the Hanover-district showed distinct dome-structures in the tertiary beds.

U.S.A.—In the U.S.A. structural surveys have been made in the salt-dome district of the Gulf coastal plain in Texas-Louisiana, in the Balcony fault-zone in Central Texas, in the Permian basin in West Texas, and in California in the San Joaquin valley and coastal basin-districts.

Gulf Coastal Plain.—The success which geophysical, especially seismic methods have scored in locating salt-domes along the Gulf Coast is well known. When the dome has been located, it has often been very difficult, however, to obtain detailed information as to extension and faulting. It has always been able to indicate the dome electrically. In the case of shallow salt-domes, the mapped sub-surface conductor shows a hole, where the non-conducting salt has penetrated the conductor. Very deep-seated salt-domes have been indicated by the dome-structure of the sub-surface conductors, above the salt. In several instances domes have been accurately outlined by the electrical investigation and often important structural details, especially faults, have been mapped at and around the dome. As examples the surveys of the Hawkinsville and Orchard salt-domes may be cited. An electrically found fault at a considerable distance from the salt-dome proved productive in the latter case, the best producer so far came in with 2,100 barrels a day.

Balcony Fault Zone.—The oil-fields in this zone are controlled by faults and it is of special importance to know the configuration of the faults. A large number of fault-indications in this area have been found. Of thirty-eight drilled indications, thirty-one proved to be faults, in five cases the wells did not give conclusive proof whether faults existed or not, and in two cases the electrical indications were proved not to correspond to faults but probably to outpinching beds.

As an example of an electrical survey in this zone, the results obtained at the Joe Bruner Field show that the electrical survey was made just when the first producer came in and the results were proved by later drilling to agree very closely with the actual structure. This field produces 20,000–30,000 barrels a day.

West Texas.—On the northern part of the famous Yates field the electrically found details with regard to the plunging of the anticline were found to be correct.

California.—Results of two electrical surveys in San Joaquin valley in Kern County and of one in the coastal plains at Fresno County were found to agree with results of drilling.

COPPER DEPOSITS IN NORTHERN VANCOUVER ISLAND

The discovery in 1928 of copper deposits near Nimpkish Lake, in northern Vancouver Island, revived interest in a locality which had been somewhat neglected since the close of last century. The Nimpkish Lake copper deposits are described by H. C. Gunning in the *Canadian Mining and Metallurgical Bulletin* for October. The author states that in less than two years some 200 mineral claims have been staked in a small area, and at least two groups have very promising surface showings. The district is, from a mining viewpoint, very accessible, and the known mineral deposits lie immediately east of the southern part of Nimpkish Lake, four miles or less from the shore. A fair trail, four miles long, leads from the lake to the Nimpkish Copper group.

The northern part of Vancouver island is densely covered with timber. It is mountainous, individual peaks attaining elevations of 5,000 and 6,000 ft. In the vicinity of the new copper discoveries, however, the mountains seldom exceed 4,000 ft., and are consequently completely covered with timber and bush. This makes prospecting exceedingly difficult. Numerous streams, fed by an abundant rainfall, offer the most promising prospecting routes, but most of them are small and abound in canyons and falls. Probably these factors account for the fact that the mineral deposits remained undiscovered for so many years, in spite of their accessibility. There are numerous lakes which afford good transportation, but the rivers, with the exception of the Klaanch, are too small for boat travel. The alternate rugged and swampy nature of the ground makes it exceedingly difficult to construct trails suitable for pack horses. The rainfall is extreme, approaching 100 in. per annum, but in spite of this the summers are frequently pleasantly dry. Extremely cold weather is unknown, the lakes freezing over only occasionally.

Geology in Vicinity of Nimpkish Lake.—(*a*) *Vancouver Series.*—The west shore of Nimpkish Lake, from the north end to a point nearly three miles north of Willow Creek, consists entirely of extrusive igneous rocks of the Vancouver series, varying in composition from andesite to basalt and including a few more acidic flows, with the exception of a body of grey hornblende-biotite granodiorite which outcrops for about half a mile opposite Halfway islands. These volcanic rocks have a general northwesterly trend and dip to the southwest, but are considerably contorted and somewhat faulted. Similar rocks, including tuffs and breccias, extend in unbroken sequence to the headwaters of Kilpala Creek and beyond to the valley of Raging River and Elk Lake. To the south, similar rocks are exposed from the middle of Hustan Lake westward to the divide between Atluck Lake and Tahsish River. On the east side of Nimpkish Lake, the outcrops from the north end to a point two miles north of the south end of the lake are also extrusives of the same character as those on the west side, with the exception of important outcrops of limestone, grey to white in colour and generally finely crystalline, 3½, 6½, 7, and 12 miles from the south end of the lake. The limestone beds are interbedded with extrusive andesites or basalts, and could be easily traced away from the lake. From Halfway Islands to the southern end of the lake, the strikes of the rocks vary from east to northeast and the dips from 10° to 30° to the south. For nearly two miles at the southeast corner of the lake, quartzites and argillites, holding poorly preserved fossils, dip very flatly south or are horizontal. Limestone, similar to that exposed on the east shore, outcrops for nearly three miles on the west shore to the north of Willow Creek. It is lying practically horizontal in a series of flat, open folds. From Willow Creek south to Anutz Lake, andesite and amygdaloidal basalt is interbedded with limestone, quartzite, and calcareous argillite, and in the latter, just south of the S.W. corner of Nimpkish Lake, were found well preserved fossils which have been tentatively placed in the Triassic.

Limestone again outcrops on the south and east shores of Anutz Lake, and thence up to and nearly halfway along Hustan Lake. The same member

passes through the centre of the Klaanch group of mineral claims and extends past Crescent Creek. On the claims, it is underlain on the east by basic volcanic rocks.

(*b*) *Intrusive Rocks.*—There are at least two, and probably more than two, important intrusions of granodiorite in the vicinity of Nimpkish Lake. One, already mentioned, outcrops on the west side of the lake opposite Halfway Islands for half a mile. It is a grey rock of fairly coarse grain, with black crystals of hornblende and biotite, and consists essentially of quartz, oligoclase, and perthitic orthoclase. It is cut by narrow, brown, aplite dykes, and is extensively fractured and jointed. The northern contact of the granite with the volcanics lies along an east-west zone of shearing, and probably faulting, and the volcanics are extensively granitized for a short distance. Epidote is also abundantly developed, and the granite itself is somewhat sheared and sericitized. The same body of granite crosses the Kilpala River in a belt two miles wide, beginning one mile from the lake and continuing for an unknown distance to the northwest.

A second body of granodiorite, similar to the above but with a more extensive development of brown and pink granitic phases, outcrops on the edge of Klaanch River at the mouth of Steele Creek, and its westerly contact continues south, approximately following the river but swinging off to the east of the canyon just north and south of Crescent Creek, for at least three miles and probably for a much greater distance. It crosses the river about ½ mile south of Crescent Creek. From the mouth of Steele Creek, the northerly contact swings almost due east for about two miles and then swings north, a large tongue of the body passing through the Nimpkish Copper group of claims about three miles east of the south end of Nimpkish Lake. The same granodiorite is exposed in the bed of Steele Creek four and a half miles east of the Klaanch, so it is a body of considerable dimensions.

As far as is known, the body described above ends a short distance north of the Nimpkish Copper showings. A similar intrusive rock was observed on the Smith group of claims, 1½ miles northeast of Lime Creek. Sufficient work has not been done to define its dimensions, but the streams flowing into Nimpkish Lake from Noomas Creek south for two miles all carry abundant float of granodiorite. Also, the writer has been informed that granite outcrops on the shores of Bonanza Lake, so that there is, in all probability, a considerable body of this rock between Bonanza and Nimpkish Lakes.

As well as the above-mentioned major intrusive bodies, there are many dykes, ranging in composition from diabase to quartz porphyry, exposed on the shores of Nimpkish Lake south of Halfway Islands and particularly on the east shore from Noomas Creek to the south end. Undoubtedly the acidic varieties and some of the green lamprophyres are closely associated with larger bodies of granodiorites.

Mineral Deposits.—The first mineral claims in the Nimpkish valley were staked in 1897 by Messrs. Hustan, Mathers, and Stark, and were located on the west side of the Klaanch River some four miles south of Nimpkish Lake. On this, the Klaanch group, 8 claims, all crown granted, are now in good standing, but little or no work has been done in recent years. During the spring of 1928, E. L. Kinman and associates found and staked the Nimpkish Copper group on Copper Creek, a branch of Lime Creek, some 3½ miles east of the south end of Nimpkish Lake. The surface showings on this group were so promising that they encouraged extensive prospecting in the neighbourhood, and during the two succeeding summers additional showings were discovered by various other prospectors.

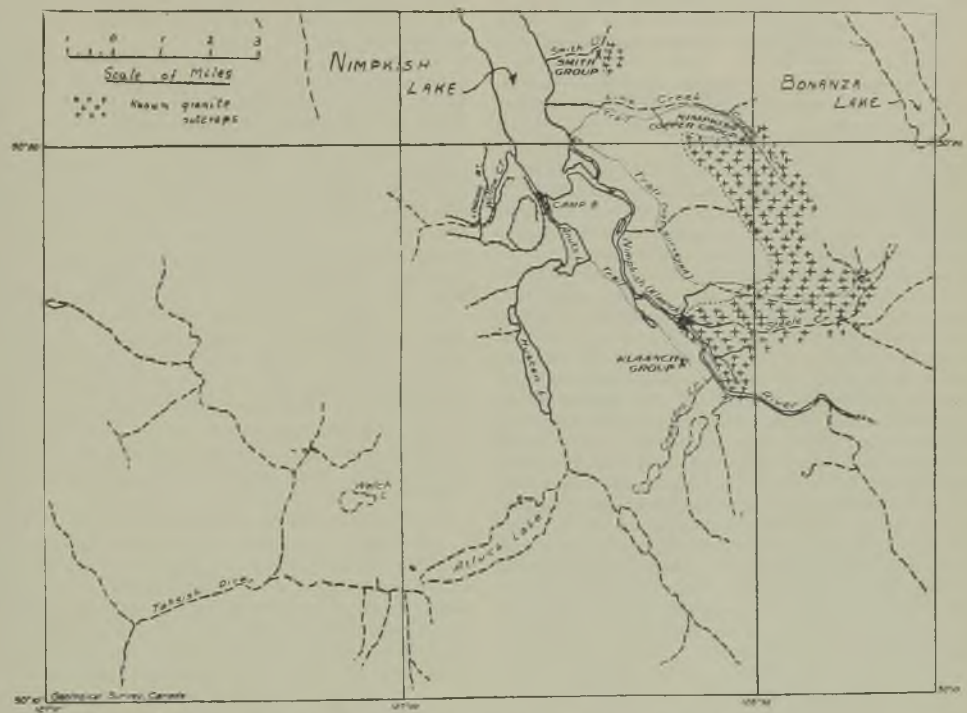
The mineral deposits of the district fall into two groups—magnetite deposits and copper deposits—the copper deposits being of greatest present interest. All the deposits belong properly to the contact metamorphic group of deposits which are so abundantly developed on the Island, although certain variations from the common type exist.

(*a*) *Magnetite Deposits.*—Numerous bodies of magnetite have been found in the region surrounding Nimpkish valley. They generally occur as irregular lenticular bodies replacing limestone and are often very pure. With the exception of deposits on the Klaanch group of claims, none have received important development. This property is developed by numerous surface strippings, a shaft, and a short adit. The showings consist of a large and persistent replacement body of magnetite, with minor amounts of pyrite and chalcopyrite, on the contact of crystalline limestone and a basic lava flow of the Vancouver series. Magnetite is most abundantly developed on the southern half of the group, widths of 25 ft. of fairly pure mineral having been observed by the writer. The gangue consists essentially of calcite and some chlorite. Contact metamorphic silicates are absent or sparingly developed in parts examined by the writer. The southern end of the deposit, where magnetite is most abundant, is close to the contact of an intrusive body of granodiorite. At the north or north-western end, the deposit has changed to a siliceous replacement with quartz, pyrite, and a little chalcopyrite. Some sphalerite was observed. The trend of the deposit, which follows the bedding of the limestone, is northwest, and the dip is probably steep to the southwest.

(*b*) *Copper Deposits.*—(i) *Nimpkish Copper Group.*—On this group of claims, a band of white to grey crystalline limestone, possibly about 1,000 ft. thick, overlies extrusive andesites and basalts of the Vancouver series. The average strike of these rocks is east and west and the dip, where undisturbed by intrusions, varies from horizontal to 15° to the south. The limestone is intruded, on the south and east, by a large tongue of granodiorite, so that the sediments and volcanics occupy a large bay in the intrusive rock. Near the granodiorite, the limestone is severely contorted, vertical dips being common, but further away from it the contortion becomes less pronounced, passing through a series of open folds to the nearly horizontal attitude. It is probable that the major structure is anticlinal around and over the intrusive body. Many fine grained, green lamprophyre dykes cut the volcanics, the limestone, and the granodiorite. Their average strike is approximately due east. On the basis of rather hasty microscopic examination, they may be classified as andesites and diorites, depending on their texture. They consist of abundant narrow laths of plagioclase felspar with some orthoclase, a little quartz, and minor amounts of chlorite, hornblende, magnetite, apatite, and augite. They have been extensivley carbonated and somewhat sericitized, so that it is

difficult to ascertain their original composition. The granodiorite consists of quartz, oligoclase, and orthoclase, with biotite, hornblende, chlorite, pyrite, and apatite forming the minor constituents. The limestone is exceptionally pure throughout, varying in colour from white to grey.

The principal mineral showings occur in the limestone, west of Copper Creek, in a zone some 400 ft. wide adjoining the contact of the granodiorite. In elevation they vary from 2,350 ft. to 3,000 ft. above sea level by barometer. At the time of examination, no work but surface stripping had been done, but this revealed important showings at intervals for a distance of about 3,000 ft. in an east and west direction along the contact zone. proved. The replacements vary in size from mere stringers to solid bodies 10 or 15 ft. wide, and these bodies are often almost pure chalcopyrite. Frequently, but not always, sphalerite is associated with chalcopyrite, and occasionally it is found as separate bodies in which there is little or no copper. Pyrite and pyrrhotite likewise vary considerably in quantity. The largest surface stripping, at the west end of the developments, exposes heavy, but erratic copper mineralization, with pyrite pyrrhotite, and sphalerite also present, over an area of about 5,000 sq. ft. Other showings are equally rich, or richer, but not generally as extensive. A particularly rich zone is exposed in the canyon of Copper Creek on the east end of the workings,



NIMPKISH LAKE DISTRICT, NORTHERN VANCOUVER ISLAND, B.C.

The contact of the granodiorite is apparently exceedingly irregular, and the distribution of the mineralization is evidently in some way related to it. Numerous dykes of granodiorite cut the limestone within the mineralized zone. The bedding of the limestone does not appear to have exerted any important control on the mineralization, but in several instances exceptionally good ore was found along the walls of the green lamprophyre dykes in the limestone.

The ore minerals identified on the property include pyrite, chalcopyrite, sphalerite, and pyrrhotite, and chalcopyrite is by far the most abundant. Oxidation products indicate that the sphalerite probably carries cadmium. The gangue minerals include calcite, quartz, garnet, epidote, actinolite, chlorite, and sericite. The ore minerals occur as irregular replacement bodies in the limestone, and no definite attitude has as yet been and lies close to the contact of the granodiorite. In all the showings, irregular blocks of limestone, showing little effect of mineralizing solutions, occur throughout the ore and may be completely surrounded by ore minerals on the surface. These blocks range in diameter from a few inches to many feet. As a general rule, contact metamorphic silicates, of which garnet is most abundant, are found in quantity only where granodiorite is exposed nearby. In many of the richest ore showings they are absent. They seem to be most abundant immediately adjoining the main contact of the granodiorite, but are also associated with small dykes of that rock. Magnetite is at times intergrown with the garnet, but, as a general rule, in the limestone away from the granodiorite, it occurs as isolated tabular bodies of fairly pure mineral. It is not generally present in the ore.

Within the granodiorite, several showings of

mineral have been found and most of them lie in the bed of Copper Creek. The best exposure is 1,400 ft. southeast of the granodiorite contact, and consists of a rather narrow vein zone, exposed for 75 ft., of sericitized granodiorite and quartz, with veinlets and disseminations of pyrite, chalcopyrite, and molybdenite. The granodiorite is extensively sheared. Further northwest, towards the contact, are other smaller showings of chalcopyrite and molybdenite, and one large undeveloped outcrop of pyrite.

At other places on the claims, well removed from the main area of mineralization, there are showings of magnetite and chalcopyrite which were not examined in detail. They indicate a widespread mineralization in the limestone and, in one place, pyrite, pyrrhotite, and chalcopyrite, with garnet, epidote, and magnetite, were noted in important amount in andesitic lava flows underlying the limestone.

The future of the property depends on the development of the showings in the limestone. The mineralization in the granodiorite and in the volcanics is, relatively, unimportant. The irregular nature of the mineralization and lack of alteration in the limestone will make systematic development somewhat difficult, but the grade of ore exposed is excellent and the surface showings are hard to beat. The depth to which mineralization, in its surface form, will extend, will no doubt depend on the depth to which the limestone persists; this question should be easily solved by drilling, as the underlying volcanics are well exposed on the claims. One of the chief points of interest is the fact that the copper mineralization is evidently distinctly later than the intrusion of the granodiorite. Undoubtedly the mineralizing solutions arose at a time when the outer crust of the intrusion was well cooled, and it is probable that they will be found to be most closely associated in time of introduction with some of the complementary dykes which are found in the area. The lack of magnetite and high-temperature silicates near much of the copper ore makes one hesitate to place the deposit in the typical contact-metamorphic group. The writer would prefer to classify it merely as a high temperature replacement deposit in limestone.

(ii) *Smith Group.*—When the writer examined this group, the claims were just being staked and, indeed, no real ore had been found. On the claims, which are on Smith Creek, 1½ miles northeast of the mouth of Lime Creek, a series of well banded quartzites are underlain by several hundred feet of limestone, which overlies a great thickness of volcanic rocks. The local strike is northwest and the dip 40° to the southwest. These rocks are cut by numerous quartz-porphyry dykes which have a general trend of N. 70° E. On the south side of the creek, a body of granodiorite, of unknown size, truncates the sediments and volcanics. Hornblende, epidote, garnet, and little pyrite, pyrrhotite, and chalcopyrite, were noticed near the contact of the intrusive and near some of the dykes. The contact of limestone and quartzites seemed to be a favoured zone for mineralization. Altogether the showings of mineralization were large, but no ore was exposed. However, the chances of discovering richer mineralization were considered to be excellent.

Conclusions.—The area surrounding Nimpkish lake and east and south therefrom is considered to be an excellent prospecting ground. Mineral deposits containing valuable copper contents have already been found adjacent to the lake, and the general geology, with its predominant northwesterly trend, enables one to extend conditions as they exist near the lake for a considerable distance to the southeast. It is to be expected that, as prospecting proceeds further away from the lake, additional bodies of granodiorite, with which the mineralization is undoubtedly associated, will be found. The work which has been done on northern Vancouver island indicates clearly that mineral deposits are found most commonly:

(1) In the general vicinity of intrusive bodies of granodiorite or similar igneous rocks.

(2) In limestone, either fairly close to such a contact or at the contact of limestone and some other rock, such as quartzite or lava, of the Vancouver series.

(3) Occasionally in andesite or basalt lava flows.

(4) Also occasionally, in sheared and fractured argillites and calcareous argillites. In this case the deposits are more likely to be quartz-calcite veins than the normal high-temperature replacement bodies of the district. It is well to remember that the acidic and basic dykes, mentioned above, when present in abundance, indicate proximity to a larger intrusive mass and, consequently, favourable prospecting ground in many cases.

CONCENTRATION EFFICIENCIES OF BLANKET MATERIALS

In *Bulletin* No. 27 of the Kolar Gold Field Mining and Metallurgical Society, A. F. Hosking has made a comparison of the concentration efficiencies of Indian black blanket and of English corduroy, in addition to comparisons of the cost and respective lives of these cloths. The author points out that blanketing is a primitive, but nevertheless efficient, method of obtaining gold concentrates which has, of recent years, almost entirely taken the place of plate amalgamation on the Kolar goldfield and on the Rand, chiefly on account of coarser crushing adopted in stamp mills. In South Africa corduroy is used extensively, but only in the tube-mill circuit. The rough riffled surface of corduroy seems to be particularly good in catching and holding the free gold sulphides, which are very readily washed off by water sprays as used in blanket machines, or by hand labour in water tanks.

When a stream of pulp is sent over a piece of blanket or corduroy, the heavier particles, falling more rapidly than the lighter ones, settle on the blanket or corduroy, and get entangled in the nap of the former, or held by the riffles of the latter, whilst the lighter particles are carried off in the current, which is of course strongest and most rapid at the surface of the stream, and slowest at the bottom. As soon as the nap of the blanket, or riffle of the corduroy, has become filled with particles of mineral, etc., it presents a smooth surface, and is thus unable to catch any more; therefore, before

this stage is reached it is necessary to wash out the particles of mineral, etc., from the blanket or corduroy, and to expose clean surfaces to the stream of pulp. It is important that the pulp should flow in a thin and fairly rapid stream, and its uniformity across the width of the blanket strake or machine is important.

Care should be exercised in the selection of the blanket, which should not be very coarse, but be strong and closely woven, with a short, stiff nap.

Mill Blanket Strakes.—The 1,250 lb. (average running weight) stamp mill at the Ooregum mine, crushes through screens 9 holes per sq. in., the duty being about 13 tons per stamp, and approximately 35 stamps are used for crushing 13,500 tons.

An inclined and adjustable wooden table, which formerly supported a copper amalgamating plate, has now a longitudinal strip down the centre, thus forming two strakes, which arrangement affords more convenient handling. The strakes are stepped into sections of about 3 ft., with 1 in. drops between. Indian black blanket is used, the top section being changed every hour, the middle section every two hours, and the bottom section every three hours. Distributing troughs are used to ensure equal apportionment of the pulp over the whole table, which has a fall of 1 in 6 or 16·6%. The pulp ratio is about 8 water to 1 ore.

The following table shows gradings of the 9-hole per sq. in. pulp, as produced and passed over the mill blanket strakes.

Screens I.M.M.	+60	+100	+150	+200	−200
Percentage	65·15	8·50	6·30	4·05	16·00

Each section is covered by a strip of blanket, the sizes being :

	Top.	*Middle.*	*Bottom.*
	3 ft. 9 in. by 3 ft. 0 in.	3 ft. 6 in. by 3 ft. 0 in.	3 ft. 6 in. by 3 ft. 0 in.
Sq. ft.	11·25	10·50	10·50
	Total sq. ft. per section		32·25
	do. per table		64·50

The consumption of Indian black blanket, 72 in. wide, on the mill strakes during 1929 was 1,705 lineal feet, or 853 sq. ft. per month. Each table requires 64·5 sq. ft. of blanket covering. The number of sets of blanket covers used per month for 7 mills, or 35 stamps, is, therefore, equivalent to 13·25, or a life of 16·5 days per set.

The cost of Indian black blanket, 72 in. wide, is Rs. 3–4–7 per yard, or 18 sq. ft., a set of covering, therefore, costs Rs. 11–12–6. Five stamps, at 13 tons per stamp over 16·5 days, would pass 1,072 tons over one set of blanket covering, the cost being ·176 annas per ton milled for mill blanket concentration.

Comparative Tests made between Indian Black Blanket and English Corduroy Cloth used on Blanket Machines in Tube-Mill Circuit.—This test was conducted over a period of 28 days. New covers were used in starting. The Indian blanket loses its nap completely after 16 days use, thus it gets less efficient rapidly, whereas the corduroy retains its corrugations, or riffling, to the last. Relative concentration efficiency is given later on in these test results.

Sizes and Costs of Covers.—

	Indian Blanket.	*Corduroy.*
Width	72 in.	45 in.
Length	2½ yd.	4 yd.

Grade or Fall on Blanket Machines = 23%.

Gradings of Tube-Mill Pulp over Blanket Machines.—

+ 60	+ 100	+ 150	+ 200	− 200
5·8	9·2	19·95	14·95	50·1 %

Dilution of Pulp over Blanket Machines.—4 water to 1 ore

Solids over blanket machine corduroy area is 1·5 tons per sq. ft. per 24 hours.

Cost per Cover.—

2½ yd. at Rs. 3–4–7 = Rs. 8–3–3 or 131·4 annas.
4 yd. at Rs. 3–4–3 = Rs. 13–1–0 or 209 annas.

Average Life.—

	Indian Black Blanket.	*English Corduroy.*
Cost per cover per day	3·75 annas.	3·42 annas.
Cost per cover per machine	131·4 as.	209 as.
Cost per 18 machines	2,365·2 ,,	3,762 ,,
Life per cover	35 days	61 days
Tons per 35 days, at 33,000 per 31 days' month	37,256	64,935
Cost per ton	·063 as.	·058 as.

Note.—The corduroy used in these tests is the first lot imported. The base of the material gave out before the riffle or corduroy part. 500 yards of 'Improved Corduroy,' have since been ordered which should give even better results on blanket machines. The writer doubts if corduroy would be economical where the washing practice is by hand labour.

Relative Concentration Efficiency.—The blanket machines at Ooregum have each a locked compartment at the back end, in which filters are fitted. The washing of the blanket is done by water spray, which plays on the blanket during its passage of one complete revolution, which is effected by turning the rollers. With these facilities it was possible to weigh the concentrates produced each day and obtain representative samples for assaying. For the tests two machines were fitted with Indian blanket and two with English corduroy, and special care was taken that the pulp to these selected blanket machines should be even as possible in density and value.

The tests were carried out over a period of 28 days, with results as below :—

	Two Blanket Machines with : *Indian Black Blanket.* 28 days' test.	*English Corduroy.* 28 days' test.
Dry weight of concentrate produced	5,769 lbs.	3,967 lbs.
Estimated gold contents	84·56 ozs.	155·23 ozs.

The corduroy gave a concentrate of 45·5%, less weight or quantity for further treatment, whilst the recovery of gold values was 83·5% higher, for 70·67 oz. more gold were extracted by the two machines using corduroy.

In his contribution to the discussion on Mr. Hosking's paper Mr. J. R. H. Robertson wrote to the effect that the Mysore mine tube-mill and blanket concentration plant was started in 1917, working on stamp mill plate amalgamation tailings and the re-treatment of dump sand cyanide tailings. As a concentrating medium various types of blankets, both of English and Indian manufacture, were tried, but in all cases the life was short, the

nap soon disappearing, with resulting fall in concentrating efficiency; neither would the material satisfactorily withstand for a reasonable time the hand-washing which is practised there. Coir matting of very fine texture was also tried, but likewise proved unsatisfactory. Thereafter, Bangalore carpets or mats, 4 ft. by 2 ft., were given a trial, and, having proved the most satisfactory material overall, they still remain in use. They now cost Rs. 3-1-0 each, and have an average life of 35 days.

About ten years ago corduroy cloth, probably of English manufacture and as used in the Rand plants, was experimented with, but this material also would not satisfactorily withstand the handling, which is as Mr. Hosking suspected. However, now that an 'improved corduroy,' to Mr. Hosking's specification, will shortly be available, it is the intention to give such a trial at the Mysore mine plant; although the material at present in use is giving highly satisfactory results.

In June last the practice of plate amalgamation after stamp milling was abandoned in favour of blanket concentration, and, as the re-treatment of dump sand had been completed at a previous date, the Mysore plant now deals only with current ore.

A comparison of Mysore methods of blanket concentration with those of Ooregum mine will, it is hoped, prove of interest and value. By a cone system of de-watering, the stamp mill pulp, ground to 8-mesh (= 64 holes per sq. in.), is reduced in bulk to about 4 water to 1 of ore, and this pulp, containing 17,000 tons ore per month, is passed over 36 mat strakes set at an inclination of 23%. By this means it is possible to deal with the above tonnage of ore on three tables, having a total mat area of 288 sq. ft.; against Ooregum's 451·5 sq. ft. on 13,500 tons = 568·5 sq. ft. per 17,000 tons, working on a 3-mesh (= 9 holes per sq. in.) pulp of 8 water to 1 of ore.

In the Mysore tube-mill circuit the same mat system is in use, the only variation being that in this case the mats are set at a 21% slope. The area of Bangalore mats in this tube-mill circuit is 384 ft. for 17,000 tons of tailings handled thereon per month; this, compared with the Ooregum figure given, of 810 sq. ft. for 33,000 tons = 417 sq. ft. for 17,000 tons. The mat costs for both stamp mill and tube-mill circuits at Mysore work out at 0·207 annas per ton handled, against Ooregum's 0·239 annas in the case of Indian blanket throughout, or ·234 annas per ton with blanket on the stamp mill strakes and corduroy on the concentrating machines in the tube-mill circuit.

SHORT NOTICES

Drag-Line Excavators.—Dipl.-Ing. Bruckmann describes recent drag-line excavator practice in Germany in the *Engineer* for October 10.

Unwatering of Mine Workings.—In the *South African Mining and Engineering Journal* for October 4, A. L. Egan mathematically analyses the time required for baling out mine workings with the available winding equipment.

Zinc Smelting.—Bulletin 324 of the United States Bureau of Mines by C. G. Maier discusses zinc smelting from a chemical and thermodynamic viewpoint.

Geophysical Surveys.—Summaries of results from geophysical surveys at various properties are given in Technical Publication No. 369 of the American Institute of Mining and Metallurgical Engineers.

Hotchkiss Superdip Magnetometer.—N. H. Stearn describes practical geomagnetic exploration with the Hotchkiss Superdip magnetometer in Technical Publication No. 370 of the American Institute of Mining and Metallurgical Engineers.

Magnetic Investigations in Economic Geology.—A paper read by R. Krahmann before the Geological Society of South Africa on July 28 discusses magnetic investigations as an aid to economic geology.

Pitchblende in Canada.—C. W. Knight, in the *Canadian Mining Journal* for October 10, describes occurrences of pitchblende at Great Bear Lake, Northwest Territories, Canada.

Microscopic Examination of Ores.—P. Ermiesco deals with the use of the reflecting microscope in ore examination in *Engineering and Mining World* for October.

Mount Isa Mines.—The first part of a description of "Mt. Isa: Its Mines and Plants," by E. C. B. Heden, appears in the *Chemical Engineering and Mining Review* of Melbourne for September 5.

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 patents.*

13,011 of 1929 (334,500). E. A. A. Grönwall and H. J. H. Nathorst, Stockholm. Ores are reduced in a shaft furnace by means of a carbonaceous reducing agent, the combustible gases escaping at the upper portion of the furnace being blown back into the charge after being admixed with a quantity of oxygen.

15,993 of 1929 (333,936). H. N. Wood and J. R. Bond, Newcastle. A foot step or shoe device is provided for steel pit props and arches which prevents them from sinking into the floor.

16,314 of 1929 (334,190). I. G. Farbenindustrie A.-G., Frankfort-on-Main, Germany. Metal carbides are removed from soot by treating the mixture of soot and metal carbides with carbon monoxide at a temperature between 50° C and 210° C, if necessary under increased pressure and with the addition of traces of sulphur as an accelerating catalyst.

18,636 of 1929 (313,858). L. Sturbelle, Stockel-Bruxelles, Belgium. Impurities in the leach liquor obtained in the acid extraction of zinc or similar metals are removed by passing the liquor through a cake of the sulphide of the metal before electrolysis.

19,385 of 1929 (334,976). I. G. Farbenindustrie A.-G. Improvements in the manufacture and production of metal carbonyls.

26,115 of 1929 (334,697). G. Dickinson, Burton-on-Trent. Arched bars fitted with shoes are employed in the support of the roof of mine workings.

27,418 of 1929 (319,356). V. Stahlwerke A.-G., Düsseldorf, Germany. The addition of finely divided copper or copper oxide to oxidic iron compounds produces a considerably increase the yield of iron carbonyl and facilitates the reaction.

27,750 of 1929 (335,051). Mines Domaniales de Potasse d'Alsace, Mulhouse, France. A source of alternating current and a voltmeter are arranged in series in a circuit at two places in the

ground, a maximum reading of the voltmeter occurring at each passage of current, whereby the earth resistances can be calculated.

31,690 of 1929 (334,761). M. Miyake, Japan. Copper glance is roasted with a mixture of red earth and bone ash, the mixture partly absorbing the sulphurous gases, thereby reducing the quantity set free.

35,614 of 1929 (334,792). S. Hunter, Penzance. In a dry cleaning apparatus for coal, of the type in which the coal drops down a chute while an air-blast removes the dust, the introduction of driven rollers across the path of the falling mineral releases much damp dust which would otherwise pass through the apparatus.

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.

A Guide to Mining in Rhodesia. By F. P. Mennell. Paper backs, iv + 160 pages, illustrated. Price 5s. 6d. Bulawayo: Rhodesian Printing and Publishing Co.

Les Minerais. Étude-Préparation Mécanique-Marché. By Ch. Berthelot and Dr. J. Orcel. Cloth, octavo, 544 pages, illustrated. Price 105 fr. Paris: Librairie J.-B. Baillière et Fils.

The Geology of the Maryport District. By T. Eastwood. Memoir of the Geological Survey of England and Wales; An explanation of Sheet 22. Paper boards, 137 pages, illustrated. Price 3s. London: H.M. Stationery Office.

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology; 1929. Part II. Paper backs, 80 pages, illustrated. Price 2s. London: H.M. Stationery Office.

Metalliferous Mines and Quarries; Reports of H.M. Inspectors of Mines and Quarries, 1929. Paper backs, 57 pages. Price 1s. London: H.M. Stationery Office.

List of Mines in Great Britain and the Isle of Man, 1929. Paper backs, 380 pages. Price 5s. 6d. London: H.M. Stationery Office.

Proceedings of the Third (Triennial) Empire Mining and Metallurgical Congress, South Africa, 1930 (In Preparation). Four volumes. Price 42s. Johannesburg: Secretary of the Congress.

The Gypsum Industry of Canada. By L. Heber Cole. Paper backs, 164 pages, illustrated, with map. Price 30 cents. Ottawa: Department of Mines.

Quebec. Annual Report of the Quebec Bureau of Mines, 1929. Part C; Geology of the Bousquet-Cadillac Gold Area, Abitibi district. By L. V. Bell and A. Maclean. Part D; Berry Mountain Map-area, Gaspe. By I. W. Jones; McKenzie, Chibongamou region. By J. A. Retty; North Shore, Tadoussac to Escoumains. By Carl Faessler. Each part in paper backs and illustrated. Quebec: Bureau of Mines.

Peace River and Grande Prairie Districts, Alberta; Geology and Water Resources. By R. L. Rutherford. Paper covers, viii + 68 pages, illustrated, with map. Price $1. Report No. 21 of the Research Council of Alberta, Edmonton.

The Geology of the Chromite and Asbestos Deposits of the Umvukwe Range, Lomagundi and Mazoe Districts, Southern Rhodesia. By Dr. F. E. Keep. Paper backs, 104 pages, illustrated, with map. Geological Survey of Southern Rhodesia Bulletin No. 16.

Gold Coast Colony: Report on the Mines Department, 1929–30. Paper folio, 22 pages, illustrated. Price 2s. London: Crown Agents for the Colonies.

Nigeria: Annual Report on the Mines Department, 1929. Paper folio, 6 pages, with appendixes. Price 1s. London: Crown Agents for the Colonies.

Nyasaland Protectorate: Annual Report of the Geological Survey Department, 1929. Paper folio, 11 pages, with map. Zomba: The Geological Survey.

Egypt: Report of the Department of Mines and Quarries, 1928. Paper boards, 44 pages. Cairo: Ministry of Finance.

Western Australia: Report of the Department of Mines, 1929. Folio size, 141 pages + 76 pages statistics. Perth: Department of Mines.

British Guiana: Report on the Lands and Mines Department, 1929. Paper folio, viii + 15 pages. Georgetown: Lands and Mines Department.

Geology and Mineral Resources of Northwestern Alaska. By P. S. Smith and J. B. Mertie, Jr. Paper backs, 331 pages, illustrated, with maps. Price $1. United States Geological Survey Bulletin 815. Washington: Superintendent of Documents.

Mineral Resources of the United States, 1929. Preliminary Summary. Paper backs, 120 pages. Price 20 cents. Washington: Superintendent of Documents.

Mineral Resources of the United States, 1929. Part I, pp. 1–4, Arsenic. By V. C. Heikes. Price 5 cents. Washington: Superintendent of Documents.

A Catalogue of British Scientific and Technical Books. New Edition. Cloth, octavo, 753 pages. Price 20s. London: British Science Guild.

Lloyd's Calendar, 1931. Cloth, octavo, 853 pages, illustrated. Price 3s. 6d. London: Lloyd's.

War Letters to a Wife. By Rowland Feilding. Cloth, octavo, 384 pages, illustrated. Popular edition, price 7s. 6d. London: Medici Society.

COMPANY REPORTS

Sub-Nigel.—This company was formed in 1895 to work a gold property in the Far East Rand. The report for the year ended June 30 last shows that 645,806 tons of ore was mined and, after waste had been sorted above and below ground, 323,800 tons was milled. The output of gold was 266,642 oz., worth £1,131,305, or 69s. 11d. per ton, and the working cost was £712,549, or 44s. per ton, leaving a working profit of £418,756, or 25s. 10d. per ton milled. Dividends absorbed £300,000, equal to 4s. per share. The ore reserves as estimated at the end of the period under review were 965,000 tons, averaging 18 dwt. over a stoping width of 23 in., an increase of 74,000 tons in amount and 0·2 dwt. in value when compared with the previous year. The sinking of the Betty Shaft was completed in July 1929, and in October it was first utilized for hoisting waste rock. The hoisting of ore was commenced and the shaft put into full commission in January last.

Zaaiplaats Tin Mining.—This company was formed in 1908 to work tin-mining properties in the Transvaal. The report for the year ended July 31 last shows that 27,864 short tons of ore was crushed, and that 1,717 tons of middlings was treated, recovering 394·7 long tons of concentrates averaging 73·88% metallic tin. In addition 3·3 tons of concentrates was purchased from tributers. The working profit for the year amounted to £13,701, of which £8,925 was paid out as a dividend equal to 10%. During the year the company purchased the property, plant and other assets of the Stavoren Tin Mining Company, Ltd., for £3,500 which amount was set off against advances previously made to the same company.

Cam and Motor.—This company was first formed in 1910 to work gold-mining properties in the Hartley district of Southern Rhodesia. The report for the year ended June 30 last shows that 288,000 tons of ore was milled, an increase of 8,000 tons as compared with the previous year. The gold recovered by amalgamation totalled 78,997 oz., by cyanidation 37,555 oz. and from the blast furnace 16,564 oz., the total 133,116 oz. being worth £564,803. The working costs were £332,720 and the gross working profit £232,083, the net working profit after payment of the B.S.A. Co. royalty being £203,843. Dividends paid during the year absorbed £150,000, equal to 20%. The ore reserves at the end of the year were estimated to be 875,400 tons, averaging 50·8s. per ton, as compared with 1,026,500 tons averaging 51·2s. per ton at the end of the previous year. This decrease is partly due to the elimination of further tonnage in pillars in the upper levels of the mine and partly to disappointing developments during the period under review.

Wanderer Consolidated Gold Mines.—This company was formed in 1928 to acquire the Wanderer Gold mining property in the Selukwe district of Southern Rhodesia from the Gold Fields Rhodesian Development Company. The report for the year ended June 30 last shows that trial crushing was started in September of the year under review and the plant brought into commission in October of the same year, the tonnage treated up to the end of June being 104,349. The recovery amounted to 25,199 oz. gold, equal to 20s. 4d. per ton treated. The plant showed an average residue value of 0·719 dwt. and to overcome this loss a third agitating vat is being installed. The working costs for the 9½ months ended June 30 last were £85,065 and the profit realized £18,808. The ore reserves at the end of the year under review were estimated to be 648,420 tons averaging 5·5 dwt. per ton. Satisfactory results in the development of the Wanderer section of the property indicate that it may be advisable to extend the plant in order that 30,000 tons of ore may be treated per month.

Filani (Nigeria) Tin Mining.—This company was formed in 1911 to work alluvial tin properties in Northern Nigeria. The report for the year ended December 31 last shows that 53½ tons of tin concentrates was produced, as compared with 44 tons in the previous year. The low price of tin prevailing however resulted in a loss for the year of £2,196. Output at the mine has been curtailed, endeavours being made to entail the least possible loss.

Yarde Kerri Group Tin Mines.—This company was formed in 1920 to work alluvial tin properties in Northern Nigeria. The report for the year ended March 31 last shows that 107 tons of tin concentrate was won during the year, as compared with 140 tons in the previous year, the average price realized being £130 16s. 4d. per ton, against £150 19s. 3d. the year before. The decreased output and the lower price realized for the product resulted in a working loss of £2,582. The tonnage of ore proved at the end of the year under review was 1,525, large areas still remaining to be prospected.

Trinidad Leaseholds.—This company was formed in 1913 by the Central Mining and Investment Corporation to develop oil lands in Trinidad. The output of this company, in common with that of others, is treated at the Company's refinery at Pointe-à-Pierre. The report for the year ended June 30 last shows that 394,819 tons of crude oil was produced and 562,813 tons purchased during the year, these figures representing a decrease of 36,765 tons and increase of 112,873 tons respectively, when compared with the figures for the previous year. At the refineries 962,566 tons of crude oil was treated, an increase of 35,136 tons as compared with the year before. After allowing for depreciation and other items the net profit for the year was £252,514 and £98,367 was distributed as a dividend, equal to 7½%. With the completion of the Guayaguayare pipe line a small monthly production from this field has been maintained. The company has, during the year, acquired the firm of Burt, Boulton and Hayward Ltd., to act as a distributing agent for the company's motor spirit. Since the completion of the pipe line of the Tocuyo Oilfields of Venezuela, Ltd., the production of these fields has been sold to Trinidad Leaseholds. The latter has also acquired important interests in Siparia Trinidad Oilfields, Ltd.

DIVIDENDS DECLARED

Billiton Company.—124.60 fl.
Burmah Oil.—2s., less tax.
Minerals Separation.—2s., less tax, payable November 14.
North Broken Hill.—9d., less tax, payable December 8.
Pahang Consolidated.—Pref. 6%, Ord. 4½d., less tax, payable December 3.
Petaling.—1½d., less tax, payable October 31.
Union Corporation.—1s. 3d., less tax, payable November 20.

NEW COMPANIES REGISTERED

B.E.P. Syndicate.—Registered October 20 as a private company. Nominal capital: £1,070 (1,050 "A" £1 shares and 400 "B" 1s. shares). Objects: To prospect and explore mines and ground supposed to contain minerals, ore, or other valuable properties, etc. Directors: Sir John R. P. Newman, G. B. Gane and A. Read. Office: 14, Copthall Avenue, E.C. 2.

Continental Oil Investment Co., Ltd.—Registered as a private company October 24. Nominal capital: £5,000 in 4,750 shares of £1 each and 5,000 shares of 1s. each. Objects: To acquire concessions, options or other interests in or over oilfields, oil wells, mines, etc. Office: 6, Conduit Street, W. 1.

COMPANY MEETINGS AND REPORTS SECTION

GOLD FIELDS RHODESIAN DEVELOPMENT CO., LTD.

Directors: E. Birkenruth (*Chairman*), S. Christopherson, W. Forbes, O. V. G. Hoare, H. G. Latilla, A. McLennan, H. C. Porter. *General Manager in Rhodesia:* Sir J. G. McDonald. *Consulting Engineer:* W. Wallace. *Managers:* Consolidated Gold Fields of South Africa, Ltd. *Office:* 49, Moorgate, London, E.C. 2. *Formed* 1912. *Capital issued:* £1,257,110 in 10s. shares.

Business: Finance of and investment in mining and land properties in Rhodesia and elsewhere.

The eighteenth ordinary general meeting of the Gold Fields Rhodesian Development Company, Ltd., was held on November 6, 1930, at River Plate House, Finsbury Circus, E.C., Mr. E. Birkenruth (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended May 31 last, said: Lord Harris has asked me to convey to you his regret at severing his long-standing connexion with our company, the interests of which he always had warmly at heart.

If I may assume that you will take the report and accounts as read, I will follow the usual course of comparing the same with the accounts of the previous year. Before doing so I think I need hardly stress the fact that we have passed through difficult times and that we have not escaped the universal depression. Moreover, as you will have gathered from our report, we had regretfully to accept the advice of our consulting engineers that the Shamva Mine could no longer be profitably operated and had to be placed in liquidation. Allowing for these adverse conditions, we have been able to hold our own fairly well, but we have considered it in the best interests of the company not to recommend a final dividend for the past year. In coming to the decision to conserve our cash resources for the time being, the directors have been largely influenced by the necessity of definitely safeguarding the requirements of their subsidiaries, notably the proposed extension of the Wanderer Mine plant, to which I shall presently refer.

Taking the profit and loss account first, the net profit was £116,658 14s., against £181,604 1s. 5d., the decrease being due to the smaller profit realized from sales and to the reduction in dividends received. Adding the balance at credit last year after the payment of the final dividend of 5% in November, 1929—namely £50,847—we have a total of £167,506, from which there were the following deductions: £6,873 depreciation written off investments, £442 spent on sundry ventures abandoned and prospecting, £4,059 for Kenilworth farm maintenance and depreciation, the interim dividend of 5% paid in May, 1930, and then the large sum of £21,491 for income-tax, to which I will again refer, leaving £71,783 to the credit of profit and loss account, as compared with £113,702 last year. Setting the expenditure against revenue, the net cost of running the company was higher than last year by £3,156—namely, £19,877, as against £16,721 in the previous year.

The Kenilworth estate shows a small increase of £520—namely, £78,061, against £77,541—due to additions during the year, less depreciation written off. This estate is situated between 50 and 60 miles from Bulawayo and 32 miles from the nearest point on the main railway line to Salisbury, Johannesburg and Capetown. The area it covers approximates close on 200,000 acres, consisting for the greater part of some of the best ranching and agricultural land in Rhodesia. We commenced the development of the estate some nine years ago, and up to date we have erected no less than 239 miles of first-class fencing with 51 specially strong gates, all made on the property. We have built two large and two medium dams, put down 28 wells varying in depth from 65 to 150 ft.; erected 14 windmills, built seven large silos and erected 33½ miles of telephone lines. In addition, we have built 11 cattle dips with stock yards, constructed 15 large reservoirs, put up 18 substantial buildings all of brick under iron roofs. Included among these is a complete and well-equipped blacksmith's shop where we make our gates and do general repair work. We have also constructed about 100 miles of roads inside the property. We grow large quantities of maize, green fodder, peanuts, etc., for native and cattle consumption on the ranch and for filling our ensilage pits. The property has on various occasions been visited by a number of well-known farmers and cattle experts, who have all remarked most favourably on its admirable situation, its valuable grasses and its general condition and development.

The Drumbulchan Estate shows no material change. It has, so to say, broken even, the year's receipts showing a small balance over expenditure, its principal revenue having been derived from tobacco.

Real estate and buildings show an increase of £2,338, the cost of fitting our own office buildings for occupation, thus effecting a considerable saving in the annual rental of premises hitherto leased and now vacated.

I have referred to our loss of revenue from the Shamva Mines, but I can give you the hope that we shall, in due course, be able to equalize this loss by revenue from the Wanderer Consolidated Mines and the Mayfair Mine, in both of which we hold a large interest. Seeing, however, that both these mines are still, so to say, in their infancy, this anticipated revenue will take time to materialize. Our representatives in Rhodesia have, as you will have gathered from their reports, been constantly on the look-out for fresh mining properties, so far without success, and it is therefore a source of great satisfaction to us that these two mines now under our control are shaping satisfactorily. This is more especially the case as regards the Wanderer Mine, where the current developments give every indication that the programme outlined to you last year will be carried out—namely, that the plant extension

will prove to be justified and the profits correspondingly increased. As you may have noted, the annual meeting has just been held and the published report is available. You will have gathered therefrom that the issued capital now stands at £600,000 and that the normal monthly profits are from £5,000 to £6,000. While this is quite satisfactory for the time being, these profits by no means represent the potential earnings of the company, its aim being, as I have just stated, to increase its crushing capacity at the earliest possible moment, and our technical advisers give us hope that this may be justified in the near future.

While the Mayfair mine also gives promise of a prosperous future, the mangement has experienced and is still meeting with many difficulties, mostly of a mechanical nature, and consequent delay in getting the mine into its stride. We have every reason to believe, however, that the original anticipations will be realized after these difficulties have been finally overcome. According to our latest advices, crushing will be resumed next month.

You will have noted that in view of individual prospecting not having led to discoveries of any importance the Government of Southern Rhodesia, in conjunction with the British South Africa Company, having recognized the beneficial results of granting exclusive prospecting rights on a large scale, have so granted an area of 9,000 sq. miles in the Melsetter and Victoria districts to a company registered as the Victoria Prospecting Company, Ltd., in which, together with a strong group of mining houses, we have taken an interest.

Lord Harris, in his address to you last year, referred to our preference for gold mining over base-metal investments, and I may therefore repeat that our interest in base-metal concerns is still kept within reasonable limits. A portion of our profits made during the past year was derived from sales, inter alia, of shares in the Rhodesian and General Asbestos Corporation and Turner and Newall, Ltd., and we have taken advantage of the lower prices since ruling to reinvest in a number of dividend-paying investments in order to secure income during the prevailing depression and pending the hoped-for increasing revenue from our holdings in the two mines referred to. We, nevertheless, retain a considerable holding in Turner and Newall, Ltd., the present market price of that company's shares under existing trade conditions being no index to their intrinsic value. That company is pre-eminent in the asbestos trade, and is certain to obtain the full benefit of any revival which is bound to take place sooner or later. Its directors claim that the company controls the major part of the superior grades of raw asbestos now produced in the world and that the quantity of that special product in reserve is practically unlimited. An interim dividend of 5% has been paid this year, as compared with a 2½% interim dividend for the previous year; but as the final dividend for the current year will not be declared until early next year it is not possible at present to make an estimate of revenue so far as our interest is concerned. You may, however, have noted from the circular that Turner and Newall have just issued that the prospects are quite favourable.

Our holding in the Celanese Corporation of America Preference and Common shares is in similar case, inasmuch as to-day's quotations of its shares reflect the present unfavourable trade conditions. We reckon on the interest on the Preference shares being duly paid, and the most recent information gives us every reason to believe that this corporation will more than hold its own in the artificial silk trade and that its prosperous future is assured.

Early in the past year we acquired an interest in the Rhodesia Katanga Company, reliable information regarding the high grade of the copper ore hitherto developed in the Kansanshi copper mine owned by that company being the main attractive feature. Although the mine is still in its initial stages development work indicates large tonnages, and metallurgical tests go to show that a large proportion of the ore can be mined by open-cast working and at reasonable cost. Meanwhile, the market value of its shares has been affected by the continuous fall in the product.

Reference to our holding in the Bwana M'Kubwa Copper Mines is made in our report, to which I have nothing to add. In this case, also, the present price of copper governs the position.

As regards our holding in the South American Gold and Platinum Company, I am sorry I cannot report any prospect of an early dividend. The continued fall in the price of platinum is now the governing factor, and until that market revives there is no likelihood of a distribution of the ample funds in hand.

As it will be obvious to you that this company's prosperity is to a considerable extent dependent on the profitable realizations of some of its assets, you will, I am sure, agree that it would be foolhardy of me to attempt to forecast the course of events during the current year. Meanwhile we shall not relax our efforts to rely on revenue from mining in Rhodesia rather than look for other fields, and if we have your agreement that this should be our principal aim we shall have no hesitation in asking you to once more extend to us your kindly support which has helped us over difficult times in the past.

Mr. H. C. Porter seconded the motion, which was unanimously adopted.

LONDON, AUSTRALIAN AND GENERAL EXPLORATION CO., LTD.

Directors : C. Algernon Moreing (*Chairman and Managing Director*), Capt. N. W. Diggle, Capt. A. H. Moreing, Lieut.-Col. G. J. S. Scovell. *Consulting Engineers :* Bewick, Moreing and Co. *Secretary :* F. E. Conway Upton. *Office :* 20, Copthall Avenue, London, E.C. 2. *Formed* 1909. *Capital issued :* £115,522 2s. 6d. in 2s. 6d. shares.

Business : Examination and finance of mining properties in all parts of the world.

The twenty-first ordinary general meeting of the London Australian and General Exploration Company, Ltd., was held on October 23, 1930, at 20, Copthall Avenue, E.C., Mr. C. Algernon Moreing (Chairman and Managing Director of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended July 31 last, said : The profit and loss account shows a reduction in expenditure for the year under review of £663 2s. 5d. The income of the company has also suffered a diminution, but you will agree with me that this is not unexpected in view of the adverse conditions that have prevailed since the autumn of last year. I am sure that you will share my satisfaction that, in spite of all the adverse factors, we find a credit of £3,359 12s. 5d. in the profit and loss account. You will note that the reserve account has been increased to £27,500 by a transfer of £4,500 from the profits available, and the balance carried forward to this year is £935 15s. 2d.

I think that an explanation is due to the shareholders of the motives which have induced the directors to deal in this manner with the reserve account. The auditor's certificate states that the prices of quoted securities show a heavy depreciation as compared with the figures in the balance-sheet, but your directors are satisfied that the true value of your company's assets is represented by the figure in the balance-sheet and, in their opinion, the amount to the credit of the reserve account is amply sufficient to cover any reasonable risks of permanent depreciation.

The past year has been one of exceptional difficulty. Commodity prices of every kind have witnessed heavy falls, and the result has naturally been to affect our income. Moreover, the stagnation of the Stock Markets has precluded any chance of dealing in the shares in which we are interested, and has cut off that source of profit to the company. What is required now, especially by those who, like ourselves, are interested in the production of raw materials, is an increased demand for the articles which are made up from our products, and my belief is that only a general fall in the level of retail prices offers a permanent solution of our problems. No doubt there are other factors which are of great importance.

The report and accounts were unanimously adopted.

TRINIDAD LEASEHOLDS, LTD.

Directors : F. R. Phillips (*Chairman*), R. Beaumont (*Managing Director*), Sir Evelyn Wallers, R. A. Macqueen, H. C. Porter, R. Walker. *Secretary :* H. S. Fuller. *Office :* 1, London Wall Buildings, E.C. 2. *Formed* 1913. *Capital issued :* £1,311,562.

Business : Production and refining of oil in Trinidad.

The seventeenth ordinary general meeting of Trinidad Leaseholds, Limited, was held on November 11, 1930, at Winchester House, London, E.C., Mr. F. R. Phillips (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended June 30 last, said that the working profit amounted to £428,860, which showed a reduction, compared with the previous year, of £207,162, due mainly to lower selling prices for practically all products. An interim dividend of 7½% was paid in May last, and the year's net profit of £252,514 would ordinarily have justified the Board in declaring a final dividend. Owing, however, to further falls in selling prices in recent months, to the general outlook in the oil industry in the immediate future, and to other considerations, the Board were reluctantly compelled to forgo the declaration of a final dividend.

The lower prices prevailing for motor spirit in the United States of America, where the major portion of their production of this commodity had been and still was being marketed, had resulted in a substantially decreased return to the Company compared with the previous year. It was this decrease in revenue from sales in America which prompted the Board to enter the motor spirit distribution market in the United Kingdom, as the net realization obtainable by direct distribution, even after allowing for the recent reduction in price, was higher than from selling in bulk to the United States. The petroleum distribution side of the business of Burt, Boulton and Haywood, Limited, was acquired as from July 1 last. Up to the present, the spirit supplied to consumers had been drawn from the stocks taken over from the Vendors and from subsequent purchases, pending the arrival of the Company's own motor spirit in this country. They now had ample supplies of their own spirit available over here and had made arrangements for its distribution under the trade name of " Regent." They were very hopeful that this branch of their business would expand, especially in view of the fact that their spirit was an Empire product. They had already received numerous inquiries for it. They would market a No. 1 and a No. 3 spirit, both of which would compare favourably with any spirit obtainable.

With regard to the company's position in the current year, the indications were that, failing unforeseen circumstances, the volume of business would not be less than that of last year. While fair profits had been earned for the first four months of the year it would be rash to attempt to forecast the final results owing to the many uncertain factors in the situation.

The report and accounts were adopted.