The Mining Magazine

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CONTENTS

EDITORIAL

THE officers of the Canadian Geological Survey, Department of Mines, have recently prepared a volume entitled "Prospecting in Canada," which, we are informed, will shortly be available for distribution.

THE question of an Australian gold bonus has again come to the front. This time it is proposed to pay a bonus of £1 an ounce on all gold produced in excess of the previous year's production and to be for a period of 10 years from January, 1931.

DURING the past month various reports have been published as to important barytes developments in the Lakeland district and 600,000 tons of barytes are said to be in sight and 2,500,000 tons out of sight, whatever that may mean. It would be interesting to know on whose authority these statements are made.

THE Council of the British Engineering Standards Association, following a decision reached at a conference recently held which included representatives from all departments of the industries affected, has appointed an Iron and Steel Industry Committee. The object to be attained is the reduction of unnecessary differences in the matter of specifications and requirements as between producer and consumer.

THE annual dinner of the Tunnellers' Old Comrades Association was held at the Hotel Victoria on November 22. Major-General Napier Harvey, who with the late Sir John Norton-Griffiths was closely associated with the formation of the Tunnelling Companies, was in the chair and the guests included Brigadier-General Sir James Edmonds, the compiler of the Official History of the War. The company numbered 81, drawn from all parts of the Empire.

IN August last attention was drawn to the significance of the Zambesi Bridge. It is interesting, therefore, to record that contracts for this work have now been entered into by a new company called Nyasaland Railways, which has taken over the undertakings and assets of the Shire Railway system. It is understood that in addition to the improved railway facilities contemplated, the Government of Nyasaland are undertaking the improvement of roads in the Protectorate and of the steamship services on Lake Nyasa.

MINING engineers may be disappointed, but they will not generally be surprised at the adverse character of the report [1] which Professor Henry Louis has made on the possibilities of developing the production of gold and other minerals in certain parts of Wales. The report reveals a very thorough investigation, based upon every relevant factor and involving the examination of a number of technical and many other witnesses, both interested and disinterested. While the map of the district issued by the Geological Survey is old and its interpretation is no longer accepted by modern geologists, yet the work of Professor A. H. Cox and Dr. A. K. Wells published in the *Proceedings* of the Geologists' Association in October, 1927, was found to be valuable as indicating that, although gold is present in the Dolgelly district, it is patchy and does not continue in depth.

THE annual dinner of the Imperial College was held on December 8 and was the occasion for the customary remarks as to the position of the College *vis-à-vis* London University. The Vice-Chancellor referred to the alliance as one of convenience out of which a more lasting affection might spring and also alluded to the assistance which the University was giving the College in the form of a substantial grant towards the new Union building. An interesting feature of this year's event was its being held in the hall of the Goldsmiths' Company, which it is to be hoped may be regarded as evidence of a strengthening of the close relationship existing between the City and scientific education in London. While it formed no part of the proceedings at this function, it is convenient to add an observation here that will be received with considerable disappointment. Mr. H. T. Tizard, the Rector of the Imperial College, speaking last month on scientific industry as a career, disclosed that for seven scholarships recently offered by mining companies, as announced in the MAGAZINE for July, not a single application had been received.

[1] London: H.M. Stationery Office. Price 3d.

The New Association

Towards the middle of November the recently incorporated Association of Scientific and Technical Institutions held a dinner at the Guildhall, which was honoured by the presence of the Prince of Wales. The occasion, as we pointed out in these columns last month, was the launching of an appeal for support of the movement which aims at the establishment of a central building to house the various constituent societies, of which the Institution of Mining and Metallurgy is one. In proposing the health of the Prince of Wales, Sir John Cadman, the honorary treasurer of the Empire Council of Mining and Metallurgical Institutions, spoke of the support which the Prince had given to the movement when it was adumbrated eight years ago and, after reminding his hearers that the project was a logical and natural development of the formation of the Empire Council, said that their immediate aim was to promote the interchange of ideas between the exponents of the various branches of science and also between them and the leaders of industry. He regarded it as a good omen for the future that several of the principal organizations of producers and manufacturers connected with the industries had agreed to make their headquarters in the same building.

The Prince of Wales, in his reply, referred to the obvious benefits of the new association, pointing out that the time had long since passed when any one industry or any one branch of science could hope to develop to its full stature without an intimate knowledge of what was going on in other departments of human activity. He expressed his confidence that the outcome of the scheme would be favourable to industry and referred to the help which had been given by the Empire Council towards the conservation of the mineral resources of the Empire. Sir Robert Horne, who followed the Prince, said that the purpose of all scientists was to serve and he was of the opinion that the association by its pooling of knowledge would be of great service to an Imperial future. Among other speakers Sir Auckland Geddes, in responding to the toast of "The Guests," reminded the industries that they should come to the help of the scientific societies, just as it was important that science and the scientist should come to the help of industry. He hoped that the assistance his associates had promised to the scheme would be increased if the equipment of a great library was carried forward and a central building provided for the whole of the scientific and technical organizations, to whom they must turn for guidance as well as for the selection of staff. It fell to the lot of Sir William Larke, president of the Iron and Steel Federation, to announce a gift from Mr. Robert Mond of £10,000 towards the cost of the central building.

When, in March last, the scheme was put before the various societies and institutions the MAGAZINE expressed the hope that the individuality of the Institution would not be lost sight of and reiterated the view that the end to be desired, as far as the Institution was concerned, was the strengthening of the status of the mining engineer. There is reason to believe that those who have represented the Institution in the progress of the negotiations have kept well in mind the maintenance of its future independence. In carrying through such a scheme, however, there could hardly fail to be views of a conflicting character. To many it has always been a matter of regret that the Institution left Finsbury Circus and it was hoped that when a further move was made it would be to return to the City, where the business activities of a number of its members are centred. There would seem to have been many difficulties in the way of this being done and the migration to Westminster was regarded as the next best thing—in fact, that any change could only be an improvement. The new association is now an accomplished fact and although the Institution may seem at the moment to be losing more than it gains it may well be the gainer in the long run. Time alone will tell.

United States Bureau of Mines

The manner in which the United States Government, through the Bureau of Mines, continues to foster the mineral industry is admirably revealed in the report of the Director, Mr. Scott Turner, on the work of the bureau during the year ended June 30 last. One of the most interesting features of the report is the way in which it deals with the safety factor in mine working. Steady progress is said to have been made in the general educational programme of the bureau, which aims at the attainment of safer and more healthy working conditions

among mine workers. More than 112,000 employees of the mining, quarrying, metallurgical, oil and gas, and allied industries were trained in first-aid or mine-rescue methods during the year under review and in the same period 181 mines or plants were given bureau certificates showing that all their employees had been so trained. The splendid results which have been obtained on the Rand by safety propaganda and the education of the native workers in first-aid and rescue work finds its counterpart in the work of the bureau. In coal mines the practice of rock-dusting as a means of limiting or even preventing mine explosions is gaining ground, as also is the use of safer explosives and electrical equipment. The co-operative agreement between the bureau and our own Safety in Mines Research Board, designed for the exchange of mine-safety information, continued to function satisfactorily. The health and sanitation problems affecting workers in the mineral industries were studied, especially with reference to poisonous gases and vapours, unwholesome dusts, and unhealthful conditions of temperature and humidity, to which the miner is frequently exposed.

The reports on mining and milling methods and costs which have been issued by the bureau during the past year have been welcomed by the mining industry, presenting as they do detailed data regarding conditions at representative mines in various districts. The plan of this series of reports was to help mill or mine operators in the solution of their own problems and its success has led to its extension into the non-metallic industries. Fundamental metallurgical data provided by the bureau and the continued studies in the microscopy of ores are affording highly valuable information on the treatment of complex ores, particularly in the solution of grinding problems. The much improved technique which has gradually been evolved for the examination of opaque minerals and which was originally, perhaps, chiefly directed to research work on the origin of ores and minerals is increasingly applied in ore-dressing. New light, for example, is being thrown on the metallurgy of copper, especially in the elucidation of leaching problems. The endeavours of the bureau directed towards the development of a chromite industry in the United States will be watched with interest, while the results of the effort to develop methods for the profitable recovery of the manganese content of low-grade manganese ores are also of importance to the rest of the world. In this respect it is noteworthy that the new processes which have been devised for the utilization of polyhalite for fertilizer purposes, which formed part of the bureau's potash exploration programme, are giving promise of success.

In addition to studying the scientific and technical problems of the mineral industries the bureau is giving increased attention to economic conditions and problems. This involves the collection and dissemination of statistical data regarding the production, consumption, distribution, and storage of the essential minerals. The results of these statistical and economic studies are generally of great interest and they are widely used by the mineral industries in keeping in close touch with the trend of markets and in estimation of the future course of their business, and for this reason alone the metalliferous industry of the world owes a great deal to the work of the bureau.

Ore Concentration

Perhaps the most striking fact emerging from the discussion of the papers before the November meeting of the Institution was the marked difference of opinion of what was and what was not useful in the theories of mineral flotation. No fewer than five papers were on the programme for introduction and discussion, of which two were undoubtedly regarded by the members present as of outstanding interest, and of these only one could justly be considered new. This was the paper by Professor B. W. Holman on " Flotation Reagents," which was in itself a concise, but remarkably complete, treatise on the various types of agents and reagents used in this branch of ore concentration, together with admirable summaries of the various theories which have been advanced to explain their action. The second of the papers referred to, " The Concentration of Ores by Flotation," had previously been read before the Empire Mining and Metallurgical Congress in South Africa and in it Mr. H. L. Sulman dealt broadly with the whole subject. The attention devoted to these two papers naturally detracted somewhat from that given to the others on the agenda, although they also were calculated to promote fruitful

discussion. That they should have been pushed into the background on the evening of their presentation is to be regretted, but it in no way lessens their value. These papers included two further contributions on flotation concentration, one by Mr. A. K. Burn on "The Flotation of Chalcopyrite in Sea Water" and one other by Mr. H. M. Morgans on "A Dressing Plant for Bideford Black." The first of these is summarized elsewhere in this issue and the other will be similarly dealt with next month. Finally, Professor B. W. Holman introduced his paper on "Water Concentration Tests," which like that of Mr. Sulman had been previously read in South Africa.

In opening the meeting the president suggested that the four papers on flotation might be taken as a whole, each introduced by its author—in the case of Mr. Burn's paper this was impossible, as the author was abroad—and finally to throw the matter open to discussion. The first paper to be introduced was that of Professor Holman, in which the different functions of reagents in general are reviewed. The author's definition of flotation "agents" and "reagents" is interesting. He confines the use of the word "flotation agent" to those agents or circumstances which have an *action* on flotation results, while the term flotation "reagent" is used to indicate those substances added in flotation to influence results by their *reaction* on pulp constituents. After stressing the two main purposes for which flotation reagents are used—namely, to control the amount and character of the froth and to enhance or reduce the floatability of the various minerals in the ore—the author goes on to discuss the bearing of physical, chemical, and electro-chemical theory on the behaviour of flotation reagents. While examining the effects of certain reagents in practice, Professor Holman considered that the application of electrochemical theory in general flotation research and also in the study of particular problems might well have important results, an attitude which was evidently opposed to that of Mr. H. L. Sulman, who, in introducing his paper, soon revealed a trust in simple physical and chemical laws which he held could be used to explain all the known phenomena. In his opening remarks Mr. Sulman expressed the view that his paper really needed no introduction, being a summary of his longer paper on the "Study of Flotation" which appeared in the *Transactions* of the Institution for 1920, a précis of which was given in the MAGAZINE for December, 1919. This summarized version had been prepared as an introduction to the subject of flotation for members of the Institute of Metals, where it had been so much appreciated that the author had been persuaded into permitting its presentation at the Empire Mining and Metallurgical Congress. Whatever the case, the result is, it will be admitted, admirable and, in spite of the divergence of opinion on theoretical matters which evidently exists between the authors of these two papers, the two together, as was suggested during the discussion by Mr. Philip Rabone, form an excellent working summary of the subject. Other contributions to the discussion on these two papers were made by Dr. S. W. Smith and Professor S. J. Truscott.

Of the two remaining papers on flotation, that of Mr. Burn, for the reason already stated, could not be introduced by the author and was left open for discussion, but the manner in which saline water has been used in the flotation of a sulphide ore in Chile cannot fail to have its application in many other parts of the world. The paper of Mr. Morgans, introduced by the author, also treats of an unusual flotation problem, thereby revealing how widely the use of this method of ore concentration has grown. In this case the problem lay in the purification of a black ochre, known as "Bideford Black," which has been in use as a pigment for a long time, the solution of the problem lying in wet grinding, flotation concentration, de-watering, and a drying plant which possesses novel features. The uses of the finished pigment were outlined during the discussion.

In his paper on "Water Concentration Tests," Professor Holman, indicates the use of panning, screening, heavy-liquid separations, and elutriation as a guide to concentration tests. The procedure and plant for working-scale tests are also discussed in the paper. It is emphasized by the author that London is well supplied with supplementary plants for ore-dressing tests on a commercial basis, but among the many interesting facts disclosed by this paper is the extent to which the foresight of the Canadian Government in providing adequate facilities for ore-testing in the Government laboratories in Ottawa has been rewarded in the economic development of mining in the Dominion.

REVIEW OF MINING

Introduction.—For the closing month of the year there has been little to relieve the prevailing dulness, but with several important companies reaching the production stage in the New Year the outlook is not altogether clouded.

Transvaal.—The output of gold on the Rand for November was 844,038 oz. and in outside districts 40,715 oz., making a total of 884,753 oz., as compared with 926,561 oz. in October. The natives employed on the gold mines at the end of the month totalled 205,030, as compared with 206,778 at the end of October.

In view of the uncertainty of world affairs in general and in particular the course of the Spanish exchange, the Central Mining and Investment Corporation deferred the payment of the interim dividend usually declared in November. The corporation, through its important interest in the Santander–Mediterraneo Railway, is intimately concerned with the course of affairs in Spain.

The report of the Consolidated Gold Fields of South Africa for the year ended June 30 last shows a profit of £330,896, derived almost entirely from the dividends on the shares in New Consolidated Gold Fields, Ltd. Adding to this amount the balance of £51,928 brought forward and deducting the £127,745 required for dividends on the preference shares, there remained an available balance of £255,079, of which £199,295 was distributed as a dividend, equal to 7½% on the ordinary shares.

Shareholders of Lydenburg Platinum Areas, Ltd., have been reminded that the production of platinum by the company is confined to two dunite occurrences and that the time has arrived when it will be necessary to deepen the Driekop and Mooihoek shafts in order to prove the deposits in depth. In view of the present low price of platinum and the uncertainty as to the persistence of values at greater depths, it has been decided to suspend operations until conditions justify the necessary expenditure and the mine was accordingly closed down at the end of November.

Cape Province.—During the year ended June 30 last the revenue of Cape Coast Exploration, Ltd., was £62,551, while expenditure totalled £17,574. After adding to the gross profits of £44,977 the balance of £73,355 brought forward and allowing for taxation and depreciation there remained an unappropriated profit of £47,884, which was carried forward. The recovery plant ordered early in 1929 was completed in May, 1930, and in the seven weeks under review 20,442 loads of diamondiferous material were treated in the new plant and 1,855·25 carats recovered. By the arrangement with the Government of the Union operations were restricted during 1929 and the company's quota had been produced by September of that year, further work being suspended until the new plant came into commission. Prior to the cessation of operations 12,834·5 carats had been produced, so that the total production for the year under review was 14,689·75 carats.

Southern Rhodesia.—The output of gold from Southern Rhodesia during October was 45,006 oz., as compared with 46,151 oz. for the previous month and 46,923 oz. for October, 1929. Other outputs for October were: Silver, 5,257 oz.; copper, 118 tons; coal, 87,571 tons; chrome ore, 8,075 tons; asbestos, 3,378 tons; mica, 23 tons; barytes, 41 tons; scheelite, 18 tons.

In the MAGAZINE for October reference was made to the sale of the Gaika mine and assets to a new company, in which shareholders were to be given an opportunity to acquire an interest. It is now proposed to wind up the company and dispose of the assets to a Rhodesian company called Q.Q. mines for £10,000. A circular accompanying the notice convening the meeting intimated that shareholders in Gaika Gold Mining were to be permitted to apply for two 2s. 6d. shares in Q.Q. mines for every five shares held in the Gaika company.

Northern Rhodesia.—The report of Roan Antelope Copper Mines for the year ended June 30 last shows that ore-reserves were estimated to be 108,000,000 tons, averaging 3·44% copper, of which 95% is sulphide. Development of the property is stated to be satisfactory and excellent progress has been made in the construction of the permanent plant and townsite and in the preparation of the mine for production. In order to provide concentrates for smelting experiments the pilot plant was re-started in November, 1929, and produced 149·7 tons of concentrates from 2,870 tons of ore. The Beatty shaft at the end of the year had reached the 820 ft. level and the main drives on the north and south limits of the ore-body have been connected around the nose of the syncline. It is stated that, while the flow of water in the mine has at times taxed the capacity of the pumps, it was at the time of the report only 850 gallons per minute and

there were signs that the water level was being lowered. During the year the options on the Roan Extension and Muliashi areas were exercised, adding 6¼ miles along the strike to the company's holdings, 237,500 fully paid shares being issued as purchase consideration for the new areas.

A quarterly report issued by Rhodesian Selection Trust, Ltd., states that it has been decided to commence the underground development of the high-grade ore-body at Chambishi and that two shafts in the foot-wall, 1,000 ft. apart, were started in October last.

The report of Mufulira Copper Mines, Ltd., for the quarter ended September 30 last states that the main Selkirk shaft had reached 107 ft. and that good progress had been made with construction work.

Negotiations have been in progress during the past week or two with regard to a fusion of the interests of the Rhodesian Congo Border Concession and the N'Changa and Bwana M'Kubwa companies. The first-named company proposes to increase its capital to £2,000,000 by the creation of 1,250,000 ordinary £1 shares, of which 550,000 will be exchanged for certain assets of the Bwana company and 126,263 for N'Changa shares. Certain expenditure of the Bwana M'Kubwa company will also be reimbursed. In addition the Rhodesian Congo Border Concession will create £6,000,000 of 7% debentures, possessing certain conversion and option rights, of which £4,500,000 will be offered to share-holders in the enlarged company.

Gold Coast.—The profit of the Consolidated African Selection Trust for the year ended June 30 last was £180,400, which, together with £106,853 brought forward, gave an available total of £287,253. Dividends amounting to 60% absorbed £149,867, debenture redemption account £40,300, income tax £6,370, and the balance of £90,716 was carried forward.

The profits of Ashanti Goldfields for November created a new record, amounting to £31,896, as compared with £30,117 in October. New developments have also been favourable, two cross-cuts on No. 24 level giving values of 18·2 dwt. over 5 ft. and 47·7 dwt. over 7 ft., and the main cross-cut on No. 26 level has also cut the reef.

Nigeria.—A circular to shareholders of Associated Tin Mines of Nigeria, Ltd., reviews the position of the company. After reminding shareholders that it has consistently supported the recommendations of the Tin Producers' Association, the circular goes on to say that the monthly output of the company's properties was reduced in January last to 200 tons per month for five months and from mid-July to mid-October only 80 tons per month was produced. The fall in tin prices has been successfully met by a progressive reduction in working costs, which were in September only £55 per ton f.o.r. Bukuru, the lowest figure so far recorded, although the average working costs for the current financial year to September 30 last have only been £63 16s. per ton. The company has not been working at a loss, the reserves and assets are being conserved, development work has been continued, and the electrically-operated plant is now in operation.

Uganda.—Mr. J. Houwert, of the Billiton Tin Company, has been appointed a director of Kagera (Uganda) Tinfields, on the board of which the Dutch company is already represented by Mr. J. Van den Broek. The Billiton interest in the British company amounts to approximately 25% of the share capital.

Tanganyika Territory.—A loss of £193,994 is shown in the report of Tanganyika Goldfields, Ltd., for the year ended December 31 last. This result has been arrived at after writing off expenditure of £86,543 in respect of the Kilimafeza gold mine, where all work has been stopped and the property abandoned. A sum of £65,000 has been placed to investment depreciation reserve and £10,000 set against loan accounts. All work on the company's properties in Africa has been suspended.

Australia.—The report of Wiluna Gold Corporation for the year ended March 31 last shows that several metallurgical discoveries have been made during the year. It has been found that the semi-oxidized ore of the East lode is amenable to treatment, that the sulphide ore of the West lode contains very little antimony, and that certain alterations in the design of the original plant would materially lessen working costs. The tests so far carried out indicate that it should be possible to recover 83% of the original values in the ore, which, it is estimated, should yield a profit of 10s. per ton. The mine is being prepared for stoping, but little exploration work was done during the year, although some new ore was discovered on the downward extension of the West lode at the 290 ft.

level. The ore-reserves at the end of the year were estimated to be 1,047,400 tons, averaging 39s. 1d. per ton, in addition to 358,000 tons of "probable" ore, averaging 38s. 6d. per ton. In order to liquidate existing indebtedness and to bring the Wiluna mines to production an issue of £300,000 of 10% 7-Year Notes, possessing certain conversion rights, is to be made. At the annual meeting to be held this month it will be proposed that the capital be increased to £1,350,000 in order to provide for the conversion rights referred to.

It is reported that an option has been taken on the Golden Butterfly mine, Norseman, W.A., by the Great Boulder company. If this is exercised £10,000 is to be paid in cash, together with 50,000 shares in a company to be formed with a capital not exceeding 240,000 shares.

India.—Shareholders of Mysore Gold Mining Company have been informed by circular that it has been deemed expedient to remove certain rich pillars of ore from the upper levels. Some of these have proved unusually rich, resulting in a gold production in excess of the normal return. It is proposed that this additional revenue should be held in reserve for future needs.

Malaya.—The profit of Malayan Tin Dredging for the year ended June 30 was £80,173, to which must be added £26,931 from the realization of investments and £98,919 brought forward. Dividends amounting to 47½% absorbed £95,000 and the balance of £110,773 was carried forward. The curtailed production of tin during the year amounted to 1,530 tons. The report of Southern Malayan Tin Dredging for the same period shows a profit of £96,678, which with the amount brought forward gave an available total of £106,796, of which £98,575 was distributed as dividends, equal to 30%. The company produced under restricted conditions 2,018 tons of tin ore.

During the year ended June 30 Southern Perak Dredging, Ltd., made a profit of £28,602, which with the £12,301 brought forward gave an available total of £40,903, of which £24,937 was distributed as dividends, equal to 18¾%. The quantity of tin ore recovered during the year was 864 tons, the price realized being £108 11s. per ton.

Siam.—A circular to shareholders of Anglo-Eastern Tin states that in order to provide for additional capital expenditure it is proposed to convert the 85,717 unissued ordinary shares into 10% cumulative preference shares and to create a further 50,000 of the latter, the whole issue to be offered to existing shareholders.

China.—The report of Chinese Engineering and Mining Company for the year ended June 30 last shows that the sales of coal by the Kailan Mining Administration during the period under review amounted to 4,750,742 tons, the company's proportion of the net profits of the administration being $3,231,733, as compared with $3,233,033 in the previous year. The company's profits have moreover been adversely affected by the fall in exchange, the net profit being £263,954. After adding the £26,438 brought in and deducting £109,104 required for income tax, there remained an available balance of £181,288, of which £176,400 was distributed as dividends, equal to 9%.

Venezuela—Interesting developments on the property of the South American Copper Company were mentioned last month. The report for the year ended March 31 last states that it is proposed to increase the capital to £400,000 by the creation of 1,000,000 new shares of 2s. each.

Colombia.—At an extraordinary general meeting of Frontino and Bolivia (South American) Gold Mining Company, Ltd., to be held this month, it will be proposed that the name of the company be changed to Frontino Gold Mines, Ltd., and that the capital of the company be increased to £243,963 by the creation of 30,000 preference shares of £1 each and 13,963 ordinary shares of the same denomination, in order to provide for the acquisition of Marmajito Mines, Ltd. No portion of the shares issued are to be allotted to the Frontino company, but all are to be divisible among the independent shareholders of Marmajito Mines. The amalgamation has been recommended in the light of examinations by the company's consulting engineers.

Panama.—The report of the Panama Corporation for the year ended May 31 last shows that development work on the concessions and subsidiary companies' property has proceeded vigorously with encouraging success. The treatment plant on Panama No. 1, which is working the Remance mine, should, according to the report of this company for 1929, be ready in March next. It will be recalled that interesting developments in this mine were recorded here last month.

A NEW CONCENTRATOR AT RIO TINTO

By R. O. STOKES, M.I.M.M., A.I.Mech.E.

The author describes a plant for the concentration of cupriferous sulphides which has been designed by the General Engineering Company

THE CONCENTRATOR.—The new concentrator recently erected on the property of the Rio Tinto Company in the Province of Huelva, Spain, is designed to handle 2,000 tons of ore per day. The ore, classed as "Chlorite Ore," comes from the North lode, and is a grey rock carrying disseminated copper sulphides. General views of the plant, in course of construction, are shown in Figs. 1 and 2.

The ore, which is hauled a distance of 6 miles to the plant in side-tipping wagons, is dumped into a pocket, from which it is fed by a Ross feeder into a 30 in. gyratory crusher. This machine, built on the Continent under the supervision and from designs of the Traylor Engineering Company, is capable of handling, with few exceptions, the largest pieces of rock excavated from the open-cast workings by steam shovel. From this larger crusher, the product, which is about 8 in. cube, is conveyed and elevated on an inclined pan conveyor and is split over two grizzlies feeding two 12 in. gyratory crushers of similar make to the 30 in. machine, which break down the ore to pass a $3\frac{1}{2}$ in. ring. The crushed ore is weighed continuously while being lifted to the top of the coarse ore-bin on a 30 in. belt conveyor.

At the point of discharge of the 30 in. conveyor a small sample is automatically taken before delivering on to a Gyrex screen. This screen, which is of the vibrating type, is clothed with $1\frac{1}{2}$ in. and $\frac{3}{4}$ in. mesh steel wire, the undersize being conveyed to the fines bin and the oversize into the coarse ore-bin over which the screen operates.

The 1,000 ton coarse ore-bin discharges through two apron feeders on to two 36 in.-wide picking belts, which have been included in the flow-sheet to make it possible to eliminate from the mill feed, as first-class ore, such pieces as are rich enough to go direct to the blast furnaces and, as waste, all ore of too low a grade to pay for fine grinding. These picking belts are of such length as to accommodate 128 men and chutes are arranged for delivering either first-class ore or waste rock on to either of the two conveyors beneath.

The first-class ore conveyors are arranged to feed into the first-class ore-bin situated alongside the coarse ore-bin, as may be seen from the plan and elevation shown in the supplement. One conveyor is fitted with a weightometer so that the amount of first-class ore picked can be accurately recorded. A sample is automatically taken

FIG. 1.—VIEW OF CONCENTRATOR FROM THE NORTH-EAST, TAKEN DURING CONSTRUCTION.

as the ore enters the bin. The waste-rock conveyor delivers to an additional cross-conveyor feeding the waste-rock bin, this ore also being weighed and sampled *en route*. The ore left on the picking belts is fed into a 5 ft. 6 in. Symons cone crusher and reduced to minus $\frac{1}{2}$ in. and elevated to the fine ore or mill storage bin.

The mill storage bin is equipped with two apron feeders regulating the feed on to an inclined belt conveyor, where it is weighed and delivered to two 10 ft. 0 in. diameter by 60 in. Hardinge ball-mills, each working in closed circuit with a 6 ft. wide Model "D" Dorr classifier and a 6 ft. wide by 12 ft. diameter Dorr bowl classifier, the sands from both machines being returned to the mill. The overflow from the straight classifiers, situated alongside the mills, is pumped to the bowl classifiers by Wilfley pumps, the final overflow of the bowl classifiers being between three and four to one dilution and approximately 68% minus 200 mesh.

After making allowances for the amount of material to be hand picked, the tonnage for which the mill is designed and which has to be fine ground is just under 1,200 tons per day, and the two large Hardinge mills deal with this amount.

Flow-sheets of flotation plants are generally subject to modification and adjustment, and in this plant this will be easily accomplished as there is ample space and liberal fall provided between all machines. The general flow-sheet of the concentrator is shown in Fig. 3 while in Fig. 4 a detail flow-sheet of the flotation section is given. From the latter it will be seen that the primary feed or overflow from the bowl classifiers passes to No. 1 cell of the rougher circuit, which consists of six 20 ft.-long Callow-MacIntosh cells. Here a rough concentrate is made, which is re-ground in a 5 ft.-diameter by 9 ft.-long Fraser and Chalmers ball-mill, working in closed circuit with an 8 ft.-diameter by 3 ft.-wide Dorr bowl classifier, the fine product of which is pumped to a conditioning tank.

The tailings from the primary rougher cell are retreated in three additional sets of cells before being discharged to waste, the middlings being eventually returned to the primary machine.

FIG. 2.—GENERAL VIEW OF CONCENTRATOR, TAKEN DURING CONSTRUCTION.

The secondary, or cleaner circuit, in which the copper is separated, is on the opposite side of the mill to the primary circuit, and the finished concentrate is taken off in the first cell, the tailings from which are re-treated in three separate groups of machines to produce a middling, which is returned to the cleaner cell. The flow-sheet of the flotation section (Fig. 4) shows the gradual progression of scavenger cell concentrates back to the primary rougher, and in similar manner the recleaning of the middlings in the cleaner circuit. The cleaner concentrates, after thickening in a 35 ft.-diameter Dorr thickener are pumped into a stock-tank which acts as a storage between the shifts and from which they are

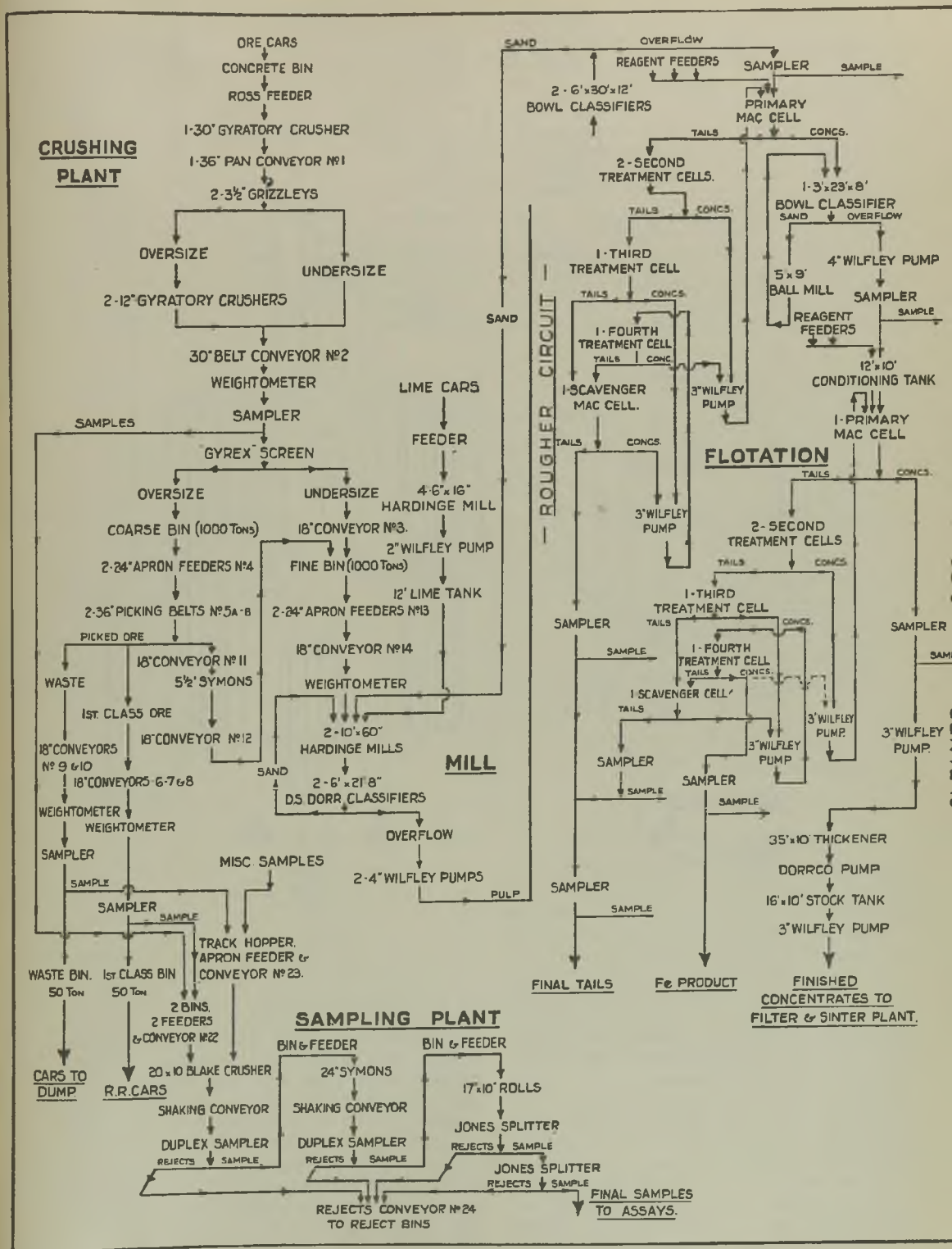


FIG. 3.—GENERAL FLOW-SHEET OF CONCENTRATOR.

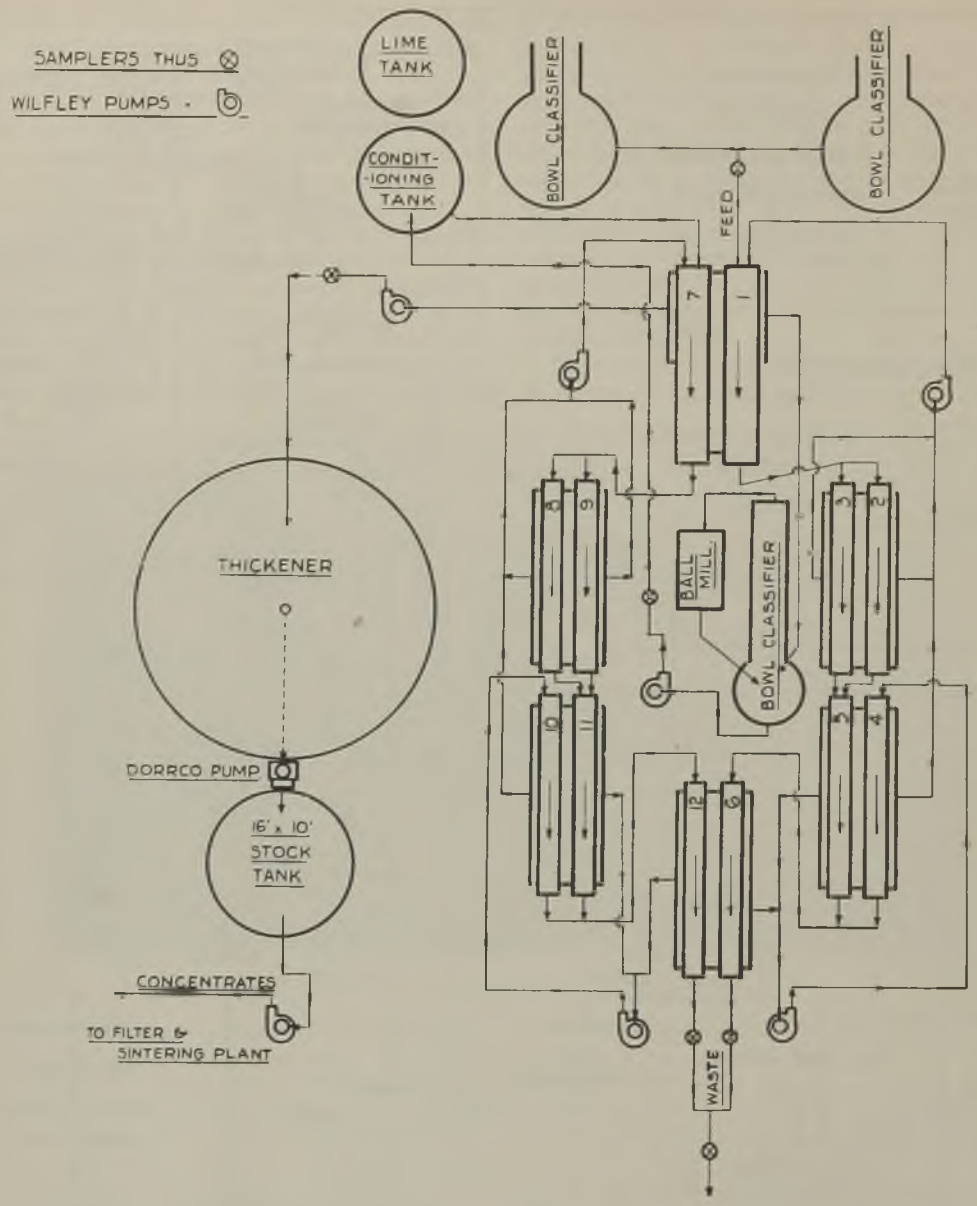


FIG. 4.—FLOW-SHEET OF THE FLOTATION SECTION.

periodically pumped to a similar stock-tank ahead of a Dorrco filter situated some 800 ft. away from the mill buildings.

It will be noticed from the drawings in the Supplement that two Handcock jigs have been placed in a convenient position near the mill feeder conveyor. These are introduced in the probability that ores will at times be available which are sufficiently high in sulphur content to yield a cupriferous sulphide concentrate by simple jigging.

The amount of lime required necessitates storage and slaking arrangements, and the accompanying plan illustrates that the lime car dumps over the top of a bin, which feeds a small 4 ft. 6 in. Hardinge mill, in which the slaking of the lime is carried out, the ground and slaked lime being pumped to the milk-of-lime agitator situated alongside the contact tank. By means of a suitable splitter, arranged at the head of a bucket elevator working inside the lime tank, the

correct quantity of milk-of-lime is fed to each ball-mill.

The tailings are impounded in two dams and all water returned to the mill. The return-water pumps are mounted on pontoons and the water pumped through floating pipes to the shore and thence to the mill water main.

There are certain refinements introduced into this mill by the designers—The General Engineering Company under the direction of Mr. J. M. Callow—which contribute towards uninterrupted operation and ensure steady conditions. The first concerns the working of two classifiers in closed circuit with one ball-mill. Under these conditions difficulty is usually experienced in the regulation of water, which is fed at various points so that adjustment at any one point interferes with the final overflow dilution, which has such influence on the final mesh of separation. A somewhat novel form of pipe arrangement has therefore been adopted and a water flow meter is installed to indicate at any time the variations in the quantity of water used throughout the day. The pipes are so arranged that all water passing the master, or lock-up, valve has a free passage into the circuit, as shown on the accompanying diagram (Fig. 5). This is accomplished by allowing the highest pipe in the system to work as an overflow and for this reason it is not fitted with a regulating valve. From it flows the balance of the water not used in the other or restricted points. In this instance this overflow pipe forms the backwash water-pipe of the bowl classifier. The air vent-pipe, shown in the diagram, is simply for the purpose of breaking any siphon action which may occur, tending to rob the water from the other outlets. In operation, therefore, the master valve is regulated to give a definite flow, as indicated on the meter, corresponding with the final overflow dilution required. The mill feed water pipe is regulated by the valve " A " in accordance with the desired moisture in the mill. The valve " B " at the mill discharge will determine the required dilution in the primary classifier, whilst the remaining valve " C " balances the surplus water divided between the feed to the bowl, the water used as backwash in the bowl classifier. Thus, if less or more water is required at the latter point the only adjustment necessary is to close or open this valve " C " without any disturbance to this final overflow.

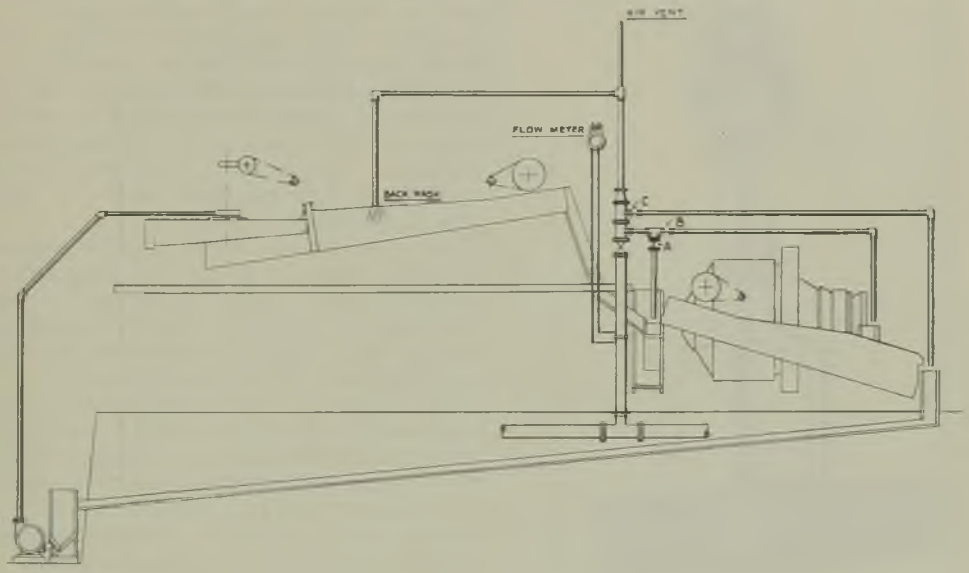


Fig. 5.—Pipe Arrangement of Ball-Mill and Classifiers.

The flow meters are of the restricted orifice type and work on the principle of the difference of pressure on each side of an orifice plate, which pressure is transferred to a mercury U tube, one limb of which contains a float. These machines are manufactured by George Kent, Ltd., and one is shown in Fig. 6.

A second refinement is the provision of density recorders on both the rougher and cleaner flotation circuits thus enabling the

operator to see at a glance what the dilution is at any moment, and if any variation has occurred during the day or night, giving a clue to other changes which cannot be detected immediately. The apparatus is illustrated in Fig. 7 and works on the principle that the pressure of a column of pulp varies with its specific gravity. It consists of a very sensitive low-pressure recording gauge specially calibrated to suit the limits required, and giving a broad reading to show up the smallest fluctuation. The diagram indicates the whole of the flow passing through the

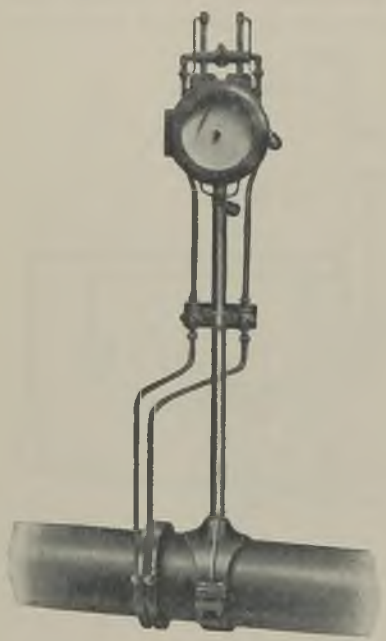


Fig. 6.—Kent Flow-Meter.

pressure measuring pot, but in large mills it will only be necessary to pass a portion of feed through this apparatus.

Recorders have also been provided, working on the principle of varying electrical conductivity of the solution, to indicate any fluctuation in the alkalinity of the circuit, and whilst they do not give a definite alkalinity content or p.H. value they are a useful guide throughout the day to any variation of alkalinity. The electrodes, spaced a certain distance apart and immersed in the pulp, will pass electric current, which varies in proportion to the salts in solution. The natural salts being comparatively constant, the added salts cause a difference in conductivity, which is recorded on the instrument throughout the day.

A five-compartment Geco flotation reagent feeder is arranged at the head of the rougher and cleaner flotation circuit to control the various reagents used throughout the flotation process.

The mill is equipped throughout with Geco samplers enabling an accurate check to be kept on the products from the various steps in the flow-sheet. These machines are well enough known to need no description here.

The blower employed for delivering air to the flotation cells has a displacement volume of 3,150 cu. ft. per minute and is of the improved Roots type built by Samuelson and Co. driven through a short centre "V" rope-drive from an electric motor. This blower is so installed that air is delivered in a downward direction into the pipes feeding the various Callow-MacIntosh cells, and the weight of the rotors is, to a great extent, balanced. This results in the very smooth running of this machine, which is fitted with ball bearings throughout.

The concentrates are finally de-watered on a 12 ft. 0 in. by 12 ft. 0 in. long Dorrco internal filter, which produces a cake described as "crumbly," which is ideal for mixing with other constituents to form a suitable feed for the sinter plant.

The Dorrco filter, which, as before mentioned, is situated some 800 ft. away from the concentrating plant, is equipped with a Nash-Hytor wet vacuum pump eliminating the necessity of any vacuum receiver or filtrate pump, which is always required when a dry vacuum pump is installed.

The Dorrco filter, in discharging its cake, relies to a great extent on the reversing of pressure and vacuum in the filtering segment at the top position and this is arranged by a pulsating valve worked automatically with the machine, alternatively causing a rotary blower to either suck or blow according to which ports in this valve are open to the atmosphere. This auxiliary blower is by Reavells of Ipswich.

Sampling Plant.—In the above description of crushing and sorting plant it is mentioned that samples are automatically taken at three points (1) where the broken ore reaches the coarse ore-bin, which can be termed "run-of-mine" ore (2) first-class ore, and (3) waste rock. The sampling plant, at present in course of construction, is at a convenient distance from the points at which the two former samples are taken to allow each sample to fall by gravity into its

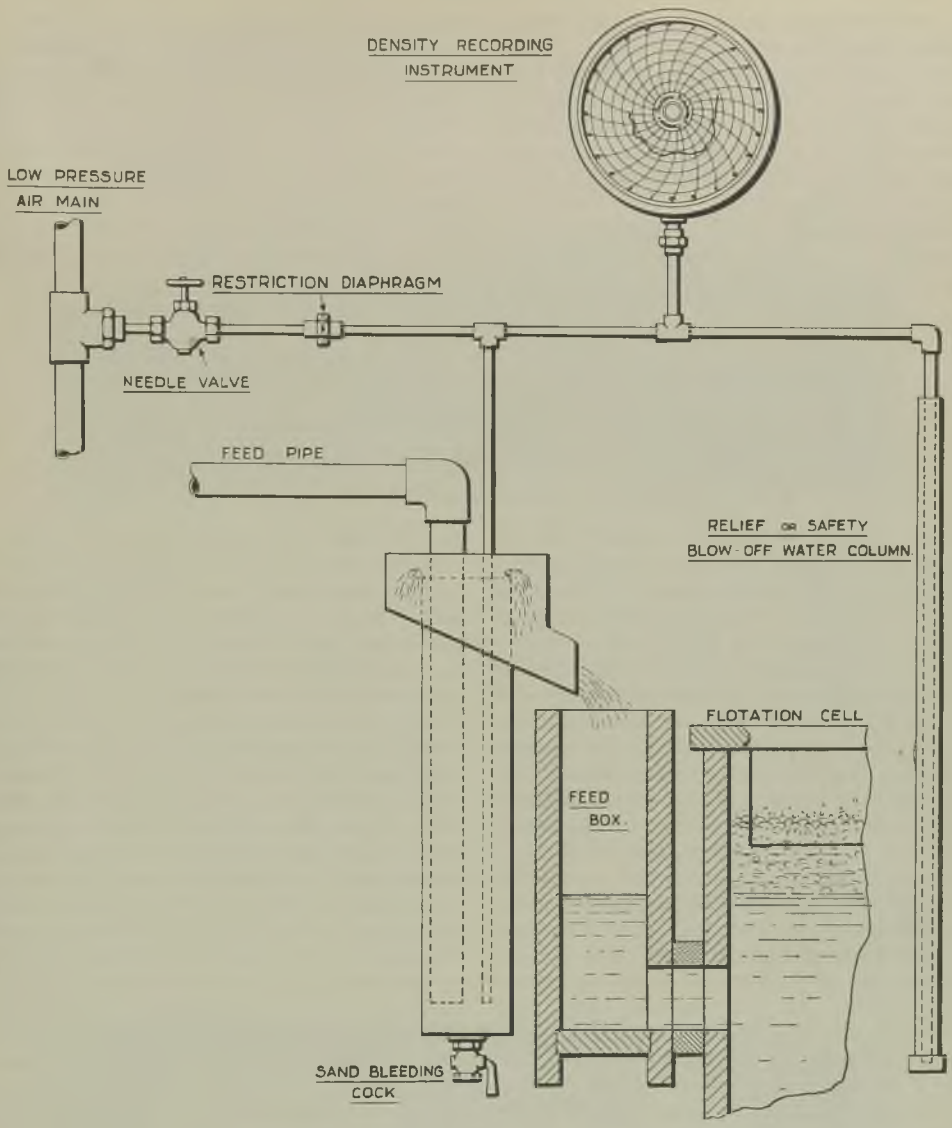


FIG. 7.—ARRANGEMENT OF DENSITY RECORDERS IN THE FLOTATION CIRCUIT.

allotted bin. Two bins are therefore provided, one for the "run-of-mine," and one for the first-class ore samples, and both are arranged to deliver on to a belt conveyor feeding a 20 in. by 10 in. Blake crusher. Beneath the mouth of the crusher the ore falls on to a shaking conveyor, feeding an inclined rejects-conveyor carrying the material to its respective bin according to the product handled, or, in the case of run-of-mine ore on to No. 2 inclined conveyor and so back on to the Gyrex screen.

At the point of delivery of the shaking conveyors a bucket on an endless chain passes through the ore stream, so taking the sample and elevating it to a small bin, where the bucket is made to discharge. This bin, receiving about one-tenth of the product from the crusher, is arranged with a feeder delivering to a 24 in. Symons cone crusher, which is arranged in a similar manner to the jaw breaker and is equipped with a similar shaking conveyor and an endless chain and bucket sampler running parallel with the first, but arranged for delivering into a smaller bin adjoining. This smaller

bin, receiving only one tenth of the Symons product, feeds a small pair of rolls.

The sample has now been reduced from about 20 tons to 440 lb. step by step through the various stages of crushing and in order to bring the final product down to convenient bulk it is further split to the amount required on a Jones splitter.

The arrangement of the plant is such that the rejects in all cases fall on to the one conveyor, and automatically discharge into the correct rejects bin. The sampling plant is arranged to handle other samples as required, which may be of larger size lumps than is convenient to handle by the above methods, and provision is therefore made, as shown on the accompanying drawings, for these miscellaneous samples and also for the waste-rock samples to be dumped in turn from side-tipping wagons over a comparatively coarse grizzley and delivered by belt to the crusher direct.

METALLURGY IN SOUTH AFRICA

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

(*Continued from the November issue, p.* 265.)

THE RAND REFINERY.—This unique feature of metallurgical activity on the Rand, and the largest establishment of its kind in the world, was naturally a source of great interest to those attending the Empire Congress. During their stay in Johannesburg, the great majority availed themselves of the opportunity afforded by the Company and by the manager (Mr. R. R. Kahan) of visiting the Refinery at Germiston a few miles to the east. This establishment, which commenced operations in December 1921, is a private company, the holdings in which are confined to gold mining companies operating on the Witwatersrand. Since that date and to the end of 1929 some 86,000,000 oz. of bullion have been treated representing a value of approximately £321,600,000. At the present time over 12,000,000 oz. are being treated annually which represents about 55 per cent. of the world's production, while other portions of the British Empire contribute a further 16 per cent.

Although the greater proportion of this bullion is produced on the Witwatersrand, the tendency is for all producers of gold in Southern Africa to avail themselves of the facilities offered by the Refinery.

The process itself is essentially that devised and initiated by F. B. Miller at the Sydney Mint in 1867 and subsequently adopted at the Melbourne, Perth, and Ottawa Mints where it is still practised. It is known as the "Chlorine Process" since it involves the removal of the base metals and also the silver contents of the bullion by the passage of a stream of chlorine gas through the metal while it is in the molten condition.

The equipment and organization which have been provided for effecting this operation constitute a striking example of metallurgical efficiency. The procedure from the receipt of base bullion to the delivery of fine bars or ingots is one of great interest. Briefly, the stages involve, first, a preliminary melting of the base bullion for the purposes of sampling by "dips" and of casting into slipper-shaped ingots for convenience in charging the refining crucibles. Each of these crucibles takes two such ingots representing about 800 oz. of bullion. The stream of chlorine gas, which is led into each crucible through a clay pipe, eliminates the base metals and the silver as chlorides which are taken up by a flux of borax. This flux is skimmed off from time to time, and finally the contents of ten of these crucibles are transferred to a tilting crucible furnace. From this furnace the metal is cast into moulds by handpouring from a small crucible which functions as a ladle.

These moulds, into each of which 400 oz. of refined gold is poured, rest, in turn, on a small weighbridge which ensures a uniform weight to each ingot. A feature of this operation is a special arrangement by which jets of acetylene gas play on to the surface of the metal during solidification. This results in the bars having a brilliantly specular surface and a convincing appearance of purity.

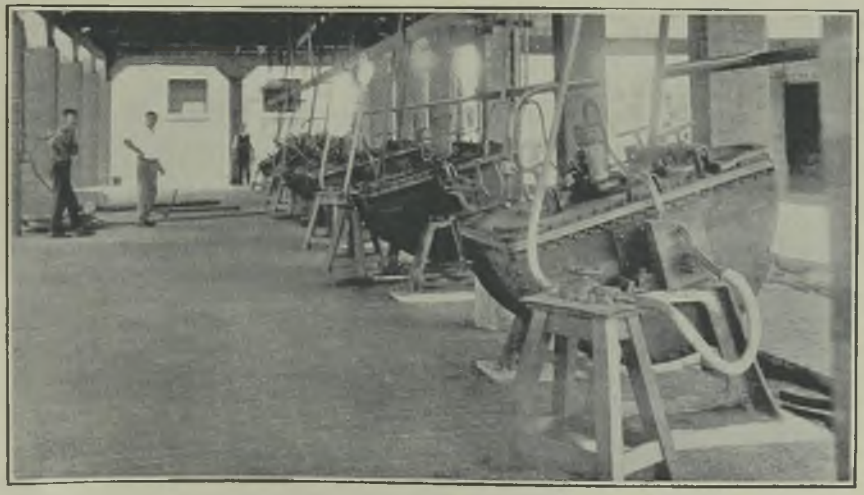
Apart from the actual production of refined gold, the subsequent procedure in treating the rich silver chlorides from the

VIEW OF THE RAND REFINERY.

refining pots is also an operation of considerable metallurgical interest. This procedure is on the lines of that followed at the Perth Mint under Mr. Kahan's direction and described in the 47th (1916) Report of the Deputy Master and Comptroller of the Mint (p. 91) and also in the 48th (1917) Report (p. 83). The mixed chlorides are first freed from gold by fusion with sodium carbonate sufficient to carry down some of the silver. The residues are treated with hot brine solutions to remove the base metal chlorides and the washed silver chloride is then reduced in vats between iron plates. The spongy silver is finally melted and cast into bars of 1,100 to 1,200 oz.

The whole of these operations are closely controlled by a staff of assayers who make some 90,000 assays for gold and silver in the course of a year.

THE RAND MINES LABORATORIES.—These laboratories constitute another important example of the benefits which have accrued to the industry from the "group system." The metallurgical problems of the various mines and of other metallurgical activities are investigated collectively under the direction of a centralized staff and with the advantages of centralized equipment. The range of work which is undertaken is a very wide one. Not only are difficulties investigated which arise in the course of the general productive work of the reduction plants,



CHLORINE GENERATORS IN THE RAND REFINERY.

but pioneer work is initiated here and "tried out" before its application to large-scale production is embarked upon.

An example of this aspect of the work of these laboratories is the immense volume of research and investigation which has been carried out in recent years in connexion with the development of the platinum industry to which further reference will be made in a succeeding article. Here again, the freedom in regard to publication of results, to which reference has already been made as characterizing the policy in technical matters in South Africa, is shown in the numerous papers, emanating from these laboratories, which have appeared in the *Journal* of the Chemical, Metallurgical and Mining Society and in the contributions to the discussions which have followed.

Of such papers, in which is recorded the work of those who are closely associated with these laboratories, mention may be made of those by Messrs. R. A. Cooper and F. W. Watson, J. R. Thurlow, E. H. Johnson, T. K. Prentice and R. Murdoch, and others. Much of this work was under the direction of the late K. L. Graham who, as Chief Metallurgist of the Rand Mines Ltd., was closely associated with its organization.

In the Far East Rand, at the Government Areas, collateral work, in regard to the metallurgy of platinum has been carried out under the direction of Messrs. F. Wartenweiler, H. R. Adam, B. W. Drinkwater and others. The immense value of collective organizations of this kind has been abundantly demonstrated by the results which have been achieved.

The Witwatersrand Co-operative Smelting Works.—(*a*) *By-Products Branch.*—This important adjunct to the gold industry is constituted on a somewhat similar basis to that of the Rand Refinery, but was of earlier origin. Founded by the mining groups through the Chamber of Mines in 1909 it receives the various by-products of the reduction plants and treats them collectively for the recovery of their precious metal contents. These contents are of course, mainly gold and silver, but an interesting and not inconsiderable feature of the operations is the recovery of the "platinum metals," which include osmiridium, from the so-called "black sands" which are collected from the crushed "banket" ore by the corduroy tables.

Pouring Unrefined Gold Bullion: Rand Refinery.

The by-products are classified under various heads such as borax slag, black sand, and refractory materials generally. After sampling and preliminary fusion trials, these various products are treated either direct in a "pan" or reverberatory furnace where the values are collected in a lead bath reduced from litharge or they undergo a preliminary sintering in Huntington-Heberlein pots followed by reduction in a blast furnace of rectangular section. A feature of the blast furnace treatment is the deliberate production of an arsenical speiss which has proved to be an excellent collector of the metals of the platinum group.

Of the three furnace products, lead bullion,

speiss, and matte, the two latter are shipped to this country for further treatment, while the lead is cupelled in an English type of "test" furnace having a fixed roof and a movable hearth supported on a carriage fitted with a tilting device. The litharge is, of course, returned to the circuit and the bullion sent forward to the Rand Refinery.

The presence of osmiridium in the "banket" ore had been known for many years before its recovery was effected on an economic basis. Various contributions to the history of its detection and recovery have been made to the *Journal* of the Chemical, Metallurgical and Mining Society and to other bodies by J. R. Thurlow, R. A. Cooper, H. Rusden, J. Henderson, Prof. Stanley and others.

Some 30,000 oz. of osmiridium have been recovered from this source.

(*b*) *The Shoes and Dies Branch.*—The exigencies of the conditions caused by the Great War led to the recovery and utilization of metallurgical material of another character. The steel scrap from the battery equipments, drills, wire rope, etc. which had hitherto been discarded has been employed for the manufacture of shoes and dies for the stamp batteries since 1917.

This is effected by melting in induction furnaces, of which there are three of one-ton capacities, the electrical power being obtained from the Victoria Falls and Transvaal Power Company. The establishment is also equipped with an arc-furnace of the standard Heroult tilting type.

The casting, re-heating, and pressing operations are all under pyrometric control. Some 7,000 tons of metal are melted annually and some 50,000 shoes and dies were produced during 1929.

The Iron and Steel Industry.—An important development in metallurgical activity and one which is likely to assume greater proportions in the near future has arisen from the consciousness of the great expansion which has taken place in other countries as the direct outcome of their iron and steel industries.

The historical aspect of the pioneer work which has been accomplished in South Africa is admirably reviewed in a paper on "The South African Iron and Steel Industry" which was contributed to the proceedings of the Congress by Mr. T. Nimmo Dewar who has been closely associated with the Union Steel Corporation and other allied bodies.

Weighing Unrefined Gold Bullion: Rand Refinery.

Mr. Dewar also gives a detailed account of the present-day position in regard to production and consumption within the Union. Of the existing companies which are actually engaged in production, he mentions:—

(*a*) The Union Steel Corporation (of S.A.) with works at Newcastle, in Northern Natal and at Vereeniging in the Transvaal —38 miles from Johannesburg.

(*b*) The Dunswart Iron and Steel Works at Benoni—some 23 miles from Johannesburg on the East Rand.

(*c*) Messrs. George Stott and Co., Johannesburg.

(*d*) The Witwatersrand Co-operative

Smelting Works, to which reference has already been made in this article.

These four establishments have this in common that they were all initiated for the purpose of utilizing scrap metal and prior to the starting up of a blast furnace at Newcastle in 1926 this constituted the sole supply of material.

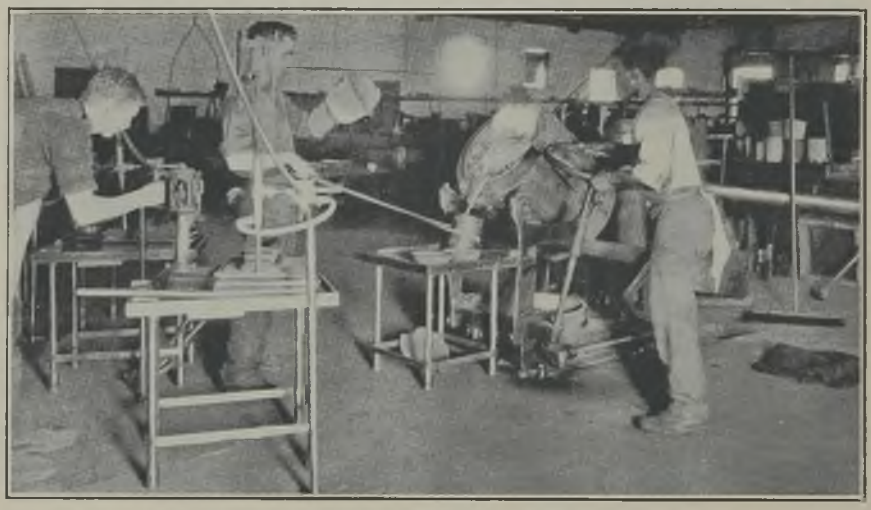
(*a*) *The Union Steel Corporation.*—When pig iron became available, the Union Steel Corporation (which had previously effected an amalgamation with the Newcastle Company) began to utilize this product to the extent of 50 per cent. in the charging base of their steel furnaces.

The works of this establishment which are situated on the banks of the Vaal River provisions are installed for re-heating, for handling, and for electrically driven mills.

In the foundry a large variety of steel castings is undertaken, while the forging department is equipped with a 600 ton forging and shingling press for handling special steel ingots. Shoes and dies are also pressed by this machine.

A feature of the operations of this establishment is the great variety of sections which are produced to meet the local requirements of the Rand.

(*b*) *The Dunswart Iron and Steel Works.*—The works are equipped with a wrought iron section and a steel foundry. The former includes the only puddling furnace in South Africa from which high-grade bar-iron is



Pouring Refined Gold : Rand Refinery.

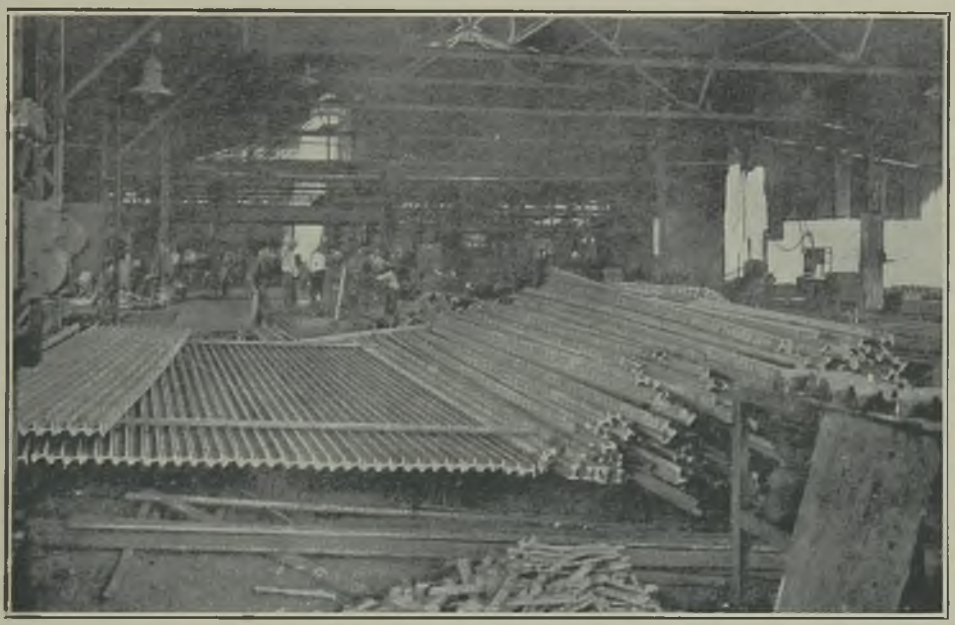
at Vereeniging were visited by a number of those taking part in the Congress, by the courtesy of Mr. Louis Marks and his fellow directors. Coal is obtained locally from the collieries of the Vereeniging Estates, Ltd. and electric power from the adjacent power station of the Victoria Falls and Transvaal Power Co. The equipment includes three basic lined Siemens-Martin open-hearth furnaces, with capacities ranging from 23 to 35 tons, and one electric furnace, basic lined, of the Heroult type having a normal capacity of from 3 to 4 tons. When working at full capacity, these furnaces are capable of producing 60,000 tons of steel ingots per annum.

The electric furnace is employed for the production of special steel ingots, shoes and dies, and steel castings, the output being from 300 to 450 tons per annum. The usual produced. The steel foundry comprises two electric furnaces of the Heroult type, each with a capacity of 7 tons, which are together capable of an output of 1,000 tons per month. A feature of this establishment is the production of alloy steels.

(*c*) *The works of Messrs. George Stott and Co.*—These are situated in Johannesburg and are equipped with steel furnaces for the use of scrap, and with a rolling mill plant. The capacity is about 500 tons per month.

The Non-Ferrous Alloys Industry.—This phase of metallurgical work is, of course, limited at present, but there are clear signs of its active development. The further progress of the steel industry will, no doubt, have a stimulating effect on the demands which will be made for non-ferrous alloys both as castings and also as worked metal.

By the courtesy of Mr. Moore of the Standard Brass and Iron Co. a visit was made to this establishment at Benoni. This concern has developed rapidly and has acquired a reputation among the engineers of the Rand for meeting their urgent needs in replacing or supplying essential parts of machinery in cases where the consequences of delay would be serious. A feature of the class of work carried out is the multiplicity of patterns which are required for these purposes. These, of course, are made on the spot. An admirably equipped laboratory is an important adjunct to this establishment.



Union Steel Works: In the Rolling Mill.

Metallurgical Training on the Rand.—Any attempt to indicate the scope and character of metallurgical activity in South Africa, and of the Witwatersrand in particular, would be incomplete without some reference to the facilities which are now afforded for the education and training of metallurgists. This formed the subject of a notable paper to the Congress by Professors Stanley and Watermeyer of the University of the Witwatersrand. They reviewed in historical sequence the evolution, during the past 35 years, of mining and metallurgical education, which is a very important feature of this University. The courses have been designed to take the fullest advantage of the unique opportunities which the University enjoys in being situated on the most important goldfield in the world. On completing their courses students are familiar with the conditions and practice of their future employment.

Graduates from this school of metallurgy, with which its distinguished head, Prof. G. H. Stanley, has been associated for so many years, are now holding important positions both at the central offices and on the various mines along the reef.

The "Work of the Metallurgist" formed the subject of an admirable address by Professor Stanley to the Chemical Metallurgical and Mining Society in November of last year. He dealt with the varied problems which confront the metallurgist and with the heavy responsibilities which are borne.

The equipment and facilities which are now provided by the University of the Witwatersrand for the training of metallurgists make it an enviable threshold for a professional career.

(To be concluded.)

Scholarships for Miners' Children.—A limited number of University Scholarships for the children of Mine Workers are to be awarded under the Miners' Welfare National Scholarship Scheme. Application forms may be obtained from the Scheme Secretary, Mines Department.

BOOK REVIEWS

The Metallurgy of Bronze. By H. C. Dews. Cloth, octavo, 147 pages, illustrated. Price 12s. 6d. London: Sir Isaac Pitman and Sons.

This little book will be found very useful by anyone who wants to learn quickly and pleasantly what is known about bronze. It should appeal to scientific metallurgists because the author has gathered together data from a large number of researches, for which they would otherwise have to refer to the original papers. It should appeal also to the practical metallurgist, not only because practical details of bronze founding are discussed, but also because the more scientific points are lucidly explained.

The book starts with an excellent chapter on the equilibrium diagram of copper-tin alloys. The constitution of the useful range of alloys is discussed, and the relation between the constitution and the physical and mechanical properties is made clear. Some parts of the subject, for example the influence of casting-temperature, and the effect of gases in bronze, are treated fully, but other parts, for instance the two short paragraphs on corrosion, are rather brief even for a book of this size. Separate chapters are devoted to various types of special bronzes, such as phosphor bronze, nickel bronze, and lead bronze, and there are also short chapters on segregation and liquation, and on foundry practice.

One of the attractive points of the book is that the author has not made the common mistake of including too much mechanical-test data in the text. The tests quoted are relevant, and they have been selected with discrimination.

The book is well printed, and is satisfactorily free from typographical errors. There is however a mistake on page 84. The allotropic change in iron occurs at 900° C., not 800° C., and the high-temperature modification which is formed at that temperature is gamma-iron, not delta. In the discussion of "coring" on page 19, too, the word "liquid", 4 lines from the bottom of the page, should read "solid." The author, incidentally, could probably improve this section with the aid of Giolitti's book on the "Heat Treatment of Soft and Medium Steels." The text is illustrated by 61 figures, which comprise equilibrium-diagrams, property-diagrams, and photo-micrographs. Most of the illustrations are well chosen, and fulfil their purpose excellently, though some of the photo-micrographs are poor.

M. S. Fisher.

The Mines of Mendip. By J. W. Gough. Cloth, octavo, 269 pages, with two maps. Price 15s. London: Humphrey Milford, Oxford University Press.

The author of this work is lecturer in history at the University of Bristol. It is a careful compilation of the history of the mining industry of the Mendip region from before the Christian era throughout the ages down to the latter part of the nineteenth century, when mining in the locality became extinct. As a record of mining work done in an area which is fast passing out of the thoughts of all mining men save those who are brought into personal touch with it, the book is a valuable addition to the historical section of mining literature, but it will be of interest to the historian rather than to the practising mining engineer.

Murray Stuart.

A Practical Treatise on Single and Multi-Stage Centrifugal Pumps. By R. Defeld. Translated by C. W. Ollivier. Cloth, octavo, 221 pages, illustrated. Price 21s. London: Chapman and Hall.

This book of some 221 pages is by the Chief Engineer of a Continental manufacturing company that produces a wide range of plant, including centrifugal—or turbine—pumps for various duties, and electric motors. The work naturally deals chiefly with the products of this Company. It is a translation from the French but the reader is conscious of this only now and again, as the translation is very well done. There are tabulations and numerous excellent illustrations, which have not been redrawn to suit the English reader, except that inscriptions are translated. The mathematics used include the calculus. The system of weights and measures is the metric. The reader unaccustomed to the metric system will be bothered by it in following the calculations. Approximate avoirdupois figures are often given, but must not be relied on.

The various types of centrifugal pump are dealt with fully, single stage with volute casings, multi-stage with diffusers, special pumps—for bore-holes and for sinking-shafts

and so on. The factors in the design are given with full calculations and formulae, so that the design of any pump could be examined critically by the help of this book and there is much to enlighten an engineer who is not a specialist on pumps, but who has to purchase or to run them. Electric motors for driving centrifugal pumps are touched upon.

There are a few mistakes—mostly obvious. An alignment diagram or nomogram is always called an abacus—a use of this word novel to the reviewer though apparently quite in order.

HUMPHREY M. MORGANS.

☛ 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.

LETTER TO THE EDITOR

The Education of the Engineer

SIR,—Your articles on the above subject have given rise to a very interesting and useful discussion. I would like to say at the outset that I thoroughly agree with the remarks of Mr. S. V. Griffith when he states that he does not think there is anything radically wrong with the training of British engineers, but that after graduation the American has decided advantages over the Briton. I am a graduate of the Camborne School of Mines and have also had experience on the teaching staff of that school and can therefore speak with a certain amount of confidence concerning the training given there. Mr. Ernest R. Woakes has, in my opinion, struck the right note when he recommends more training in mechanical subjects and also in book-keeping and costing. During a recent extensive tour of the mining districts of the United States and Canada I had the opportunity of visiting several of the mining schools of those countries and was greatly impressed with the facilities which are afforded the students of gaining practical experience in the mines and works. Many of the students spend the whole of their vacations in working as ordinary labourers in the mines, thereby gaining valuable first-hand knowledge of all kinds of actual operations and at the same time earning money to help towards the payment of college fees. I am quite convinced, along with Mr. Arthur J. Bensusan, that if before entering on a course at a school of mines a student has already received some form of practical instruction in mine or works he will be better enabled to appreciate the lectures and other class work. A young man entering the mining profession should have some knowledge of the conditions which he will experience after graduation.

WM. A. EDWARDS.

Calama, Chile.
October 15.

NEWS LETTERS

JOHANNESBURG

November 6.

Another Prospecting Concession.—The area granted to the Consolidated Mining and Smelting Company of Canada borders on the old concession area of the Kaokoveld and the Minen Gesellschaft, which has lately been much in the public eye and which is held by the South-West African Company and the Otavi Minen and Liserbaum Gesellschaft. The two latter concerns produce copper, lead, silver and vanadium. Seventy-five per cent. of the prospecting area can be abandoned in the three years succeeding the first at the rate of 25% per annum. The company has the right to peg claims in terms of the Mining Ordinance and the development of any mineral occurrences will be a matter apart from the grant. The company will pay the Administration a rental of 1s. per sq. km. per annum on the total area held at any time. Operations will be started immediately on the arrival of a technical and field staff from Canada. The unskilled labour will be recruited in the territory.

New Manganese Agreements.—The Manganese Corporation, which holds many miles of manganese-bearing land in the Postmasburg district has completed arrangements with two smaller concerns for the purchase of their ore. One of the agreements signed a few days ago provides that, subject to the provision by South African Manganese, Ltd., of the necessary additional working capital for railway sidings, plant, machinery, etc., within a reasonable time, the Manganese Corporation will for a period of 10 years take a minimum quantity of 6,000 tons of manganese ore per month, with the probability of a considerable increase

in that quantity at a price which the directors of South African Manganese consider very satisfactory. The extensive prospecting work done by the South African Manganese, on certain of its farms has already exposed a substantial tonnage of manganese ore of exceptionally good grade and structure. Under the other agreement the Manganese Corporation will purchase from the Hay Base Metals (Proprietary) Ltd., 2,000 tons of ore per month for the first two months and thereafter 4,000 tons per month, to be increased to 6,000 tons per month, from the farm Klipfontein in the Hay district. Provision has been made for the construction of a 2 ft. 6 in. railway from the existing railway belonging to the corporation to the Farm Klipfontein. The railway will be constructed either by Hay Base Metals at its own expense, with the financial assistance of the corporation, if so desired, by way of a loan on very easy terms of redemption, or, alternatively, the line will be constructed by the corporation. The right to mine the manganese ore on the farm Klipfontein is vested in Manganese Fields, Ltd., and this company has transferred these rights to Hay Base Metals against payment of a royalty per ton.

Transvaal Emeralds.—Although there are seven registered companies in the Transvaal interested in beryl mines, only one, the Beryl Mining Company, is actually producing and prospering. Suspension of operations is due in some cases to restricted demand. The main deposit on the Beryl Mining Company's property is contained in a hill, and is bounded by pegmatite dykes on three sides, the northern boundary being formed by the Murchison Range schists. The emerald-bearing schist is a dark biotitic and chloritic rock. The surface is characterized by an occurrence of talc schist, which is much convoluted and is barren. In 1928 an adit was driven into the side of the hill, about 40 ft. vertically below the crest. This was cross-cut in both directions, but owing to the cramped nature of the work imposed by this method, open-cast mining has since been adopted, which allows more space for blasting with low-grade explosive, and permits of speedier and more economical development of the claims. The claim area is now being extended in a northerly direction. It is confidently expected that better crystals will be met with at depth. Those found near the surface often show the effects of weathering, and the cleavage planes of the crystals are filled with alteration products, which greatly depreciate their value and prevent the cutting of large "stones." The retail value of the best stones from the company's mine has been placed at an average of £65 per carat. Four stones, totalling nine carats and cut from a single crystal, realized £100 per carat.

Alluvial Gold in Swaziland.—Fullerton Gold Fields (Proprietary), Ltd., has been formed at Capetown with a capital of £3,500 to work a large gold-bearing alluvial deposit in the Steynsdorp Valley, Swaziland. At various times during the rainy season small nuggets of gold have been recovered from the deposit and the late Dr. David Draper interested himself in the occurrence to some extent, but did no serious work there. The alluvials acquired by the Fullerton Company are thus, to all intents and purposes, a virgin proposition and the company has set about operating the deposit on well planned and systematic lines. The working conditions are described as being ideal. The presence of from two to three million cubic yards of gravel containing gold to about the value of 3s. per cu. yd. has been determined. It is considered that working expenses should not be in excess of 4d. to 6d. per cu. yd. so that substantial profits can reasonably be expected.

Resuing Method of Stoping.—At the Sub Nigel mine large-scale tests by means of surface crushing have recently been carried out to determine the amount of gold in fines from the packed waste in stopes worked by the resuing method. The results of these tests and the high cost of resuing have led to a gradual decrease in the amount of ore being won by this method, which is now used only in special cases. At the City Deep mine the resuing system, according to the manager, Mr. A. V. Lange, has brought better recovery of the gold in the ore broken, better ventilation at the working face and better support for the hanging-wall. The system has proved of great advantage in deep level mining, but its full value will not be felt for some time. During the past nine months the City Deep has averaged a monthly fathomage broken of over 9,500 and nearly 70% of this has been broken by the resuing system.

New Mill for Shabani Asbestos Mine.—A new central mill is being erected at the great Shabani asbestos mine, in Southern Rhodesia, to turn out four uniform grades of fibre.

Storage accommodation with a capacity of 20,000 tons is also being provided. The first unit of the new mill will be ready in March next. The Havelock mine in Swaziland, which was purchased by Turner and Newall, Ltd., some months ago, has not yet been equipped for production. It is being held in reserve, owing to the restricted market for chrysotile. The latter factor is also responsible for the accumulation of stocks of asbestos at the mines. Work at the producing mines, however, is not being curtailed, as it is expected that the market will recover sooner or later.

Rhodesian Scheelite.—A discovery of scheelite has been made 45 miles east of Fort Victoria (Southern Rhodesia) and near the border of the exclusive prospecting area which was granted recently to the Victoria Prospecting Co., Ltd. It is stated that three parallel reefs have been found which carry scheelite in addition to epidote and olivine. One of these reefs has been exposed along its strike for a distance of 90 ft. and it varies in width from 7 ft. 6 in. to 10 ft. A shaft, which is now 12 ft. deep, is being sunk on this reef, which at this depth is solid across the floor of the shaft and gives good pannings of scheelite. A second reef, 125 ft. to the north, has been exposed over a few feet by the removal of the surface soil and is 7 ft. 6 in. wide and carries visible scheelite crystals. A further 350 ft. to the north there is an outcrop of a similar reef, which can be traced for 100 ft. along its strike. Development work is progressing on the property.

BRISBANE

October 20.

Progress at Mount Isa.—Development work is being pushed ahead at the Mount Isa mines as fast as circumstances will permit. According to the report of the district inspector of mines (Mr. Fletcher Young) for September, however, a great deal of trouble is still being experienced with water, which is seriously impeding progress in the man and supply shaft. Between this shaft and the Davidson shaft, on the Black Star lode, Mr. Young says, about 2,500,000 gallons of water is being raised daily from a vertical depth of 400 ft. Instead of being able to drive continuously, according to plan, from both ends of the main haulage levels simultaneously, the excessive amount of water met with has, for the time being at least, confined driving work in this level to the south end, which is operated from the main haulage shaft. Progress here is being made at the rate of 100 ft. weekly. This is accomplished by having four machines running off two bars and a mechanical air shovel for mullocking. This level being dry, work can be carried on without any trouble. In this shaft cages have been installed in place of buckets and haulage has been considerably expedited

Rifle Creek Dam: Mount Isa Mines.

in consequence. Good progress is being made in the erection of the electric hoist and new head-gear both here and at the man and supply shaft, and this should soon be placed in position.

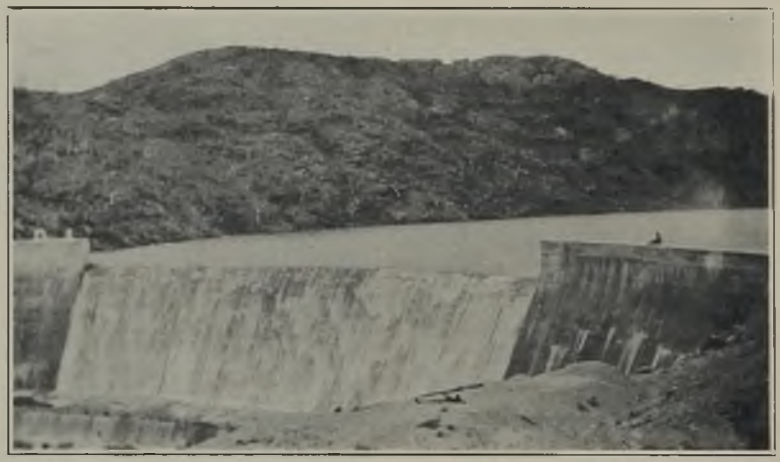
During the four weeks ended September 20, 819 ft. of diamond drilling was done on the Black Star lode. Official reports show that in 5C bore-hole, at 1,512 ft., the core assays from 1,512 ft. to 1,532 ft. average 21·6% lead and 18·5 oz. silver per ton. The hole continued in ore to 1,627 ft. The assays for the whole of the core from 1,512 ft.

to 1,627 ft. were 10·7% lead and 9 oz. silver to the ton. Ore of good grade was also cut in No. 1D bore-hole at 1,583 ft. and the drill continued in ore to 1,657 ft. From 1,583 ft. to 1,657 ft. assays averaged 11·0% lead and 9·6 oz. silver per ton. In both 1D and 5C bores assays of this section of the lode show lead values higher, and higher silver contents, than in more shallow bore-holes. Both of these holes were drilled on the southern portion of the Black Star lode.

The drives and cross-cuts were extended in the same period for an aggregate distance of 721 ft. On the Black Star, the "show" lode of the field, the seven glory-holes have been all completed from the surface to the main haulage level. In the east drive from the supply shaft to the Urquhart shaft work was temporarily suspended on September 20 owing to the supply shaft being flooded. During the four-week period the west drive from the Urquhart shaft to the supply shaft in the main haulage level was advanced 286 ft.

Mr. Julius Kruttschnitt, for the past 18 years in charge of the south-western development and exploration division of the American Smelting and Refining Company, has been appointed manager at Mount Isa, and is now on his way to Australia. This American corporation, it will be remembered, in August last not only acquired a substantial interest in Mining Trust, Ltd., to be applied in the development of the Mount Isa mines, but agreed to place at the disposal of the Trust, for a minimum period of ten years, the benefit of the experience, assistance, and advice of its large technical staff, which is highly trained in the management and administration of mining properties, including smelting and refining plants.

Mount Isa Water Supply.—The chief provision made for supplying the Mount Isa mines with water is a dam on Rifle Creek, a tributary of the Leichardt River. The site chosen for the dam itself is an ideal spot for the purpose and lies across a gorge in the creek 20 miles up the Leichardt from Mount Isa. The capacity of the reservoir is 1,400,000,000 gallons. The water is backed some two or three miles up the creek, forming an extensive lake. The water from the reservoir flows through a pipe-line leading to the power-house at the Mount Isa mines,



View of Rifle Creek Dam: Mount Isa Mines.

which are situated on the western bank of the Leichardt River. While there is now in storage for Mount Isa enough water for three years' operations, even if there is no rainfall during that period, the Mount Isa Company—or rather the Mining Trust, Ltd. which holds the controlling interest—has, as an additional assurance, secured the right over another water storage basin, also 20 miles from Mount Isa, on the Leichardt River, at a point where there is a permanent flow, and where there is a rain catchment area of over 1,000 square miles. At the same time, for domestic purposes there has also been developed by bore-holes and laid on to the new buildings sufficient water of excellent quality to supply the needs of all employees.

The New Mount Morgan.—The newly formed company (Mount Morgan, Ltd.) which bought the Mount Morgan mine from the old company last year, has presented its

first annual report. Like other mining concerns, the enterprise has been greatly handicapped by the extremely low prices of metals, coincident with high costs and a world-wide financial stringency. It is satisfactory to learn, however, that, as a result of the experimental work which has been carried out, it has been proved beyond all doubt that the Mount Morgan ore, *in situ*, is ideal for leaching. Enough has been done to put the proposition on a sound basis, but the company has not been able to complete the reticulating scheme outlined in its prospectus. This will cost about £6,000, and the directors are endeavouring to arrange for additional finance to finish a scheme for treating the readily accessible ore, amounting to about 600,000 tons. This ore the American Cyanamid Company has agreed to test and to advise as to the best method of treatment. Its chief value is its gold content. In the leaching operations so far carried out, altogether nearly 97,000,000 gallons of liquor, containing 4·52 lb. of copper per 1,000 gallons, had up to the end of June been pumped and treated. The year's operations showed a working profit of £8,501, which was converted, by interest, cost of development, and other over-head charges, into a loss of £221. Copper precipitates were produced amounting in value to £10,446, and the total revenue was £22,280. Mr. A. A. Boyd, for many years General Manager under the old régime, who is a director and consulting engineer in the new company, has now full control at the mine.

The Old Mount Morgan.—The old company (Mount Morgan Gold-Mining Company, Ltd., in liquidation), from which Mount Morgan, Ltd., purchased, has just issued a statement showing that, after having made a total distribution to shareholders of 23s. for each share, there is available for a further and final distribution 10½d. per share, which will be made on December 15. The capital of the old company was £1,000,000, in £1 shares.

Lawn Hills Silver-Lead Field.—On the Mining Trust's concession at Lawn Hills, in the Burke district, North Queensland, a good deal of preliminary work has been done since the beginning of this year, when operations started. Early in January two American geologists (Messrs. R. Blanchard and A. J. Maese) arrived on the field, and in February Mr. D. W. Ayres, mining engineer, joined the party. The initial work was geological and mapping was completed before drilling was started. With the first plant available (one transported from Mount Isa, 200 miles to the south) drilling was begun in April on leases called the Silver King. Of two other drills, which were sent from overseas and were set up in May, one has been used continuously on the Silver King area for the systematic drilling of a series of bore-holes, on what have been designated the A and C lines. On the A lines four holes have been bored, and the No. 1 C line is now being drilled. The Mount Isa plant is being returned to that place. The other one remaining at Lawn Hills has been employed in the prospecting of various outcrops away from the Silver King leases. There are about 20 men employed on the field. Domestic water for the camps is being got from Lawn Hills Creek, which runs continuously, while that needed for the drilling plants is being obtained from an old shaft on the Silver King leases.

Other Concessions to Overseas Companies.—Another English mining company has applied to the Queensland Government for concessions in this State. The areas sought cover in all about 70,001 acres and are six in number, being scattered over several mineral belts in the North, one being on the old Hodgkinson gold field and another near Georgetown, in the Etheridge field. One of the conditions asked for the concessions is that the company shall spend £5,000 on each block. The company negotiating has been favourably reported on by the Queensland Agent-General in London (Sir Edward Macartney). The State Premier (Mr. A. E. Moore) has stated that the Government is getting a lot of overseas inquiries from mining people who want concessions, on which they are prepared to spend from £5,000 to £10,000 a year in prospecting. Some time ago Mr. E. C. Hunter, at one time a member of the Queensland Parliament for a northern constituency, received a concession from the State Government for 360 acres on the old and once famous Palmer River goldfield, in the Cooktown district, and it is now reported that he has arranged with an Anglo-French company to make available £100,000 for the development of the field.

Silver-Lead Find in New South Wales.—An official report has been published of a very rich and remarkable deposit of silver-

lead ore discovered at Newee Creek, about three miles from Nambucca Heads, in New South Wales. Six tons of ore obtained from a shallow trench, when treated at Dapto, yielded silver at the rate of 226 oz. per ton, while a number of assays made in the laboratory of the State Department of Mines, from samples taken from various places along the line of outcrop, gave exceedingly rich results. Until, however, further sinking and trenching have been carried out, no definite opinion can be given as to the quantity of rich ore that the lode is capable of yielding.

Broken Hill Mines.—At the annual meeting, held in Melbourne, of the Broken Hill South, Ltd., the chairman (Mr. Colin Fraser) said the working of this mine affords a livelihood to some 1,100 employees. The transport of coal supplies to the mine is primarily responsible for keeping a tramway and the northern section of the South Australian railways running, while the big smelting works at Port Pirie, employing 1,200 men, is dependent almost entirely for its ore supplies upon the lead concentrates from Broken Hill. The mining annually of nearly 300,000 tons of coal, the manufacture of 50,000 tons of coke, and the transport of this fuel to the Barrier, with pig-lead back to Sydney for shipment, supports another army of workers and their dependents.

IPOH

November 7.

Price of Tin.—In the latter half of October there was a slight recovery from the lowest prices recorded in that month; but since the beginning of November the price of tin has again fallen heavily. There is a general feeling that apart from normal market business speculative operations must be largely responsible for the present situation and if so that there should be inquiry as to how such artificial conditions can be prevented.

Labour.—Monthly returns of the labour engaged in Mining show that the total employed in the four States of the Federation had fallen from 104,468 in December, 1929, to 75,661 at the end of September, 1930 a decrease of nearly 29,000, but it is estimated that 80% of those who have for the present given up mining have found other employment.

Restriction Effects.—The result of restriction of output or stoppage of dredges has been to alter materially the proportion of output from European owned mines. The following are the figures for April and for September of the present year for comparison :—

	European Owned Mines.			Owned and worked by
Month.	*Worked by the companies.*	*Sublet to Chinese.*	*Total.*	Chinese.
April	56%	10%	66%	34%
September	37%	17%	54%	46%

The statistical position according to the latest available figures is as in the return by the Registrar General of Statistics, S.S. & F.M.S. dated November 3. Foreign exports of tin, being final shipments on ocean-steamers at all Malayan ports during the month of October, 1930 :

Destination.	*Tons.*
United Kingdom	195
United States of America	4,763
Continent of Europe	1,702
British Possessions	534
Japan	139
Other Foreign Countries	30
Total	7,363

This return represents shipments during the calendar month, irrespective of date of receipt of exporters' documents.

Foreign Imports of tin ore during the month of October, 1930, amounted to 3,973 tons.

Directors of dredging companies seem now to be taking the only economically sound course in the circumstances, and there are now at least 25 dredges out of action in order to avoid wasting the companies' ore at unremunerative prices.

F.M.S Chamber of Mines.—At times of difficulty in the industry the Chamber of Mines might be able to give valuable service through free exchange of views and otherwise, but in this respect the F.M.S. Chamber of Mines is handicapped by its method of conducting business. Its activities are virtually restricted to what can be done or arranged at the monthly meeting of a small council, and though the members of such a council do all that could be expected of them, and invite written representations from other members of the Chamber, it can hardly be claimed that the needs of the case are fully met. It would be an improvement if all members of the Chamber had the opportunity to meet once a month, leaving the council to perform its functions afterwards or on another occasion. Recent proposals for the formation of a mine

managers' association, apart from but to be represented in the Chamber of Mines, confirm that the latter does not at present meet the needs of the industry. It is very doubtful if additional associations would be more serviceable than the existing Chamber of Mines could be made. If monthly meetings of the Chamber in Ipoh do not give all the facilities desired, branches could be formed in each of the chief mining states to meet before the monthly meeting of the Chamber thus giving much wider and more frequent opportunities for discussion of problems affecting the industry.

VANCOUVER

November 10.

Portland Canal.—With the usual dividend cheques, covering operations for the third quarter of this year, shareholders of Premier Gold Mining Company received notice that the profits of operation up to September 30 indicate that the profit for the full year will fall slightly below $1,000,000, or $200,000 below the dividend requirements at the present rate of 24% per annum. Moreover, it is expedient that some cash be conserved so that the company may acquire other properties should favourable opportunity arise. Shareholders, therefore, must expect a reduction in the dividend rate commencing with the last quarter of this year. The company paid its first dividend on January 4, 1921; up to October 4, last, it has disbursed $15,163,117 and therefore has returned to its shareholders their capital with more than 200% interest in less than 10 years. At the present rate of production the existing reserve will maintain operation for two years, and, though the managing director on several occasions has warned shareholders that opportunities for finding new ore appear to have been exhausted, the company has managed to develop some new ore each year. In fact, during 1929 only a small inroad was made on the reserve. Profits from the Premier have also developed the Porter-Idaho, Prosperity, and Silverado properties. The last has been abandoned, but if the present rate of production is maintained until the end of this year there will be a net profit of around $250,000 from the operation of the Prosperity mine for this year. Some shipments have been made from the Porter-Idaho, but as yet this mine has not been brought to the stage of steady production.

Consolidated Mining and Smelting Company of Canada, which is financing the development and equipment of the Big Missouri mine in consideration for bonds in the holding company, Buena Vista Mining Company, has almost completed its construction programme and is assembling the machinery for the 100-ton pilot mill. This, it is understood, will go into operation before the end of this year. The new buildings include a boarding house to accommodate 46 men, mill building, and buildings for coarse crushing plant, officials' residence, office, assay office, blacksmith's shop, etc. Silver Crest Mines, which owns and has done a considerable amount of exploration on a property adjoining the Big Missouri mine, refused an offer by Tacoma capitalists to spend $100,000 on development and equipment of the property before the end of 1931 for a controlling interest in the company, and made a counter offer that the Tacoma people should spend $250,000 before the end of 1932 for a controlling interest, with the impossible clause that they cannot withdraw from the undertaking if development proves unfavourable. Unicorn Mining Company, which also holds property adjoining Big Missouri territory, in driving a tunnel to open a mineralized zone, which is 50 ft. wide and has been traced at the surface for 600 ft., has cut a previously unknown mineralized zone in which is a 30 in. quartz vein that shows gold freely. The tunnel will be continued during the winter to undercut the surface showing at a depth of about 150 ft., and the new vein will be explored.

Alice Arm.—Utility Mines No. 1 Company has made a final payment of $60,000 and 200,000 shares in the company to E. E. Pickett for the Tiger group and Rose Marie claims, adjoining the Toric mine, in the Upper Kitsault River district. As at the Toric, owing to the fall in the price of silver, no work has been done on the property this season. Kitsault River Mining and Developing Company, which has been doing surface work on its property at Kitsault glacier, has uncovered a mineralized zone carrying lenses of gold-copper ore. The zone is 18 to 20 ft. wide, and samples from the lenses assayed up to $48·50 in gold per ton and 31% copper. The discovery was made in stripping a vein of calcite 2 to 6 ft. wide, which also carries gold-

copper ore. Exploration will be resumed in the spring. Dolly Varden Properties, the holding company for Dolly Varden and Wolf mines, and Alice Arm–Dolly Varden Railway and rolling stock, is contemplating selling its assets to liquidate liabilities of some $30,000, preparatory to winding up the company. Britannia Mining and Smelting Company bonded the properties about a year ago, but dropped them when the price of silver fell below 40 cents. The mines are straight silver mines, and there is little prospect of interesting other developing companies in them.

Queen Charlotte Islands.—Kitsault-Eagle Silver Mines, which suspended development on its properties in the Alice Arm district early in the season and acquired the Skidegate-Sunshine group, situated at the south end of Graham Island, has done some 500 ft. of sinking and cross-cutting and has exposed a wide belt carrying stringers and lenses of high-grade gold ore. Owing to the spottiness of the deposit it is difficult to arrive at an average of the whole belt without a mill test. Several small consignments of selected ore, totalling about six tons, have brought returns from the Tacoma smelter ranging from $100 to $360 in gold per ton, and the last consignment, which weighed 1,100 lb., brought the astonishing return of $4 per lb. New hoisting and pumping equipment is being added. At the northern end of the Graham Islands, Queen Charlotte Syndicate has been experimenting, with a device known as the Hanssen precious metals separator, throughout the season on the ferruginous sand found along the shores of Masset Inlet and Hecate Strait, but so far without much success. The sand contains a good deal of magnetite and garnet and has a low gold content which has enticed many people to the district at different times, but up to now no one appears to have been able commercially to separate the gold, which is fine and flaky. The syndicate proposes to resume its experiments next season.

Nicola.—Premier Gold Mining Company has withdrawn from Planet Mining and Reduction Company's property at Stump Lake, after having made an exhaustive sampling of the mine, and now the Planet company is reported to be negotiating with Consolidated Mining and Smelting Company of Canada to take over the development and further equipment of the mine. In the meantime, the main shaft has been sunk from the 350- to the 400-ft. level in ore that is said to be richer than any previously found in the mine. Regular weekly shipments of concentrate are being made.

Kamloops.—A good deal of prospecting is being done on Mount Ollie, some 60 miles up the North Thompson River from Kamloops, as the result of the discovery of a mineralized belt, carrying lenses of auriferous arsenopyrite and pyrrhotite, by Mr. Peter Johnson and partners. Premier Gold Mining Company's engineers have examined and sampled the discovery, and have taken a developing option on the claims staked by Mr. Johnson. The company has cut a trail to the property, the Lakeview group, and is constructing a camp and taking in supplies and machinery with a view to exploring the property thoroughly. Assays run from $80 to $130 in gold.

Field.—Base Metals Mines Corporation has closed its mill at the Monarch mine, but expects to restart it again in the spring. Winter operation is slightly more costly than summer and it is hoped that lead and zinc prices have about touched bottom and that there will be some improvement by the spring. The company has been making a small profit at existing prices. The ore is mined and milled cheaply, but freight and treatment charges on the concentrates are said to amount to double the cost of mining and milling the ore. Development will be continued during the cessation of milling. The last 140 ft. of driving on the West Monarch ore-body was through ore averaging 20·8% lead, 17·6% zinc and 2·8 oz. of silver per ton. The deposit ranges from 23 to 34 ft. in thickness.

Revelstoke.—Snowflake Mining Company has closed its mine at Albert Canyon, having exhausted its funds. The company is being re-organized and its capital has been increased to 5,000,000 shares by the creation of 2,500,000 new shares at 50 cents par. Regal Silver Mines, which is developing the Morton-Woolsey mine, adjoining the Snowflake, recently made a trial shipment of 25 tons to Tadanac. French Creek Developing Company, which has done a considerable amount of dead work in developing some placer leases at Big Bend, has made a clean-up of gold valued at $2,700 from 900 cu. yd. of gravel. The company hopes to make another clean-up before the weather causes a cessation of work until next spring.

Britannia Beach.—Britannia Mining and Smelting Company produced 3,605 oz. gold, 11,656,379 lb. copper, and about 50,000 oz. silver during the third quarter of this year, which brings the company's production for this year to the end of September up to 9,165 oz. gold, 34,803,818 lb. copper, and about 160,000 oz. silver. Howe Sound Company, the holding company for the Britannia company has paid its regular quarterly dividend of $1 per share for the third quarter of this year, though the net profit was some $40,000 below the dividend requirement. The total net profit for the first three quarters, however, was well ahead of dividend requirements. The Britannia company and Granby Consolidated Mining, Smelting and Power Company are now conferring with the other Canadian producers with a view to curtailing their copper output until there is an improvement in the demand for the metal.

TORONTO

November 18.

Porcupine.—The production of bullion by the gold mines of the Porcupine area during October was valued at $1,507,071, from 206,715 tons of ore, as compared with $1,416,573 from 207,412 tons in the preceding month. The new mill of the Dome Mine has gone into operation, treating an average of 1,500 tons of ore per day. It differs considerably from the old mill, stamps having been eliminated, together with amalgamation, the cyaniding process which is generally in use in the gold mines of Ontario being employed. A considerable reduction in operating costs is anticipated and ore reserves are sufficient to keep the mill in operation for four or five years. A report issued by the Hollinger Consolidated for the nine months ended September 30, showed production valued at $7,728,599. Operating expenses were $5,032,532, making a profit from operations of $2,690,977. Income from other sources amounted to $443,994, making a total surplus, before dividends were paid, of $3,134,971. The average recovery per ton was $6·38 showing a slight improvement over last year. The operating costs averaged $4·16 per ton as against $3·95, the increase being mainly due to a large quantity of developing rock being put through the mill, thereby lowering the average grade. The McIntyre Porcupine is maintaining production at a high level. Since the middle of the current year, the output has been somewhat over $400,000 per month. Net earnings after providing for taxation have exceeded $180,000 per month, dividend requirements calling for $198,000 quarterly which leaves the company with net earnings of $114,000 monthly. The new mill will increase the capacity by about 35%. The Vipond during the fiscal year ended July 31 made operating profits of $385,974 before deductions for depreciation etc., as compared with $300,544 for the previous fiscal year. The bullion produced from 113,329 tons amounted to $896,397, the average recovery being $7·91 per ton. Underground work is being carried on to prove the downward continuation of the ore discovered on the 400 ft. level and which has been encountered on the 500 ft. level. At the Coniaurum a winze is being put down from the 2,000 ft. level, its objective being 3,000 ft. Levels will be run at 2,250 and 2,500 ft. from which exploration will be conducted by diamond drilling. A high-grade vein has been encountered in the shaft of the Canusa at a depth of 300 ft. which will be tested by diamond drilling.

Kirkland Lake.—The six producing mines of Kirkland Lake yielded bullion during October to the value $1,488,098 from the treatment of 121,758 tons of ore as against $1,451,358 from 102,227 tons of ore during September. The additions to the mill of the Lake Shore have been completed and bring its capacity to 2,000 tons per day. Preparations are being made to extend developments to greater depths. A winze will be sunk from the 2,000 ft. level with 2,800 ft. as its first objective. No. 3 shaft has been completed to a depth of 2,485 ft., from which a cross-cut from the 2,325 ft. level has intersected the main vein. October production is close to $800,000 as compared with the usual average of about $600,000. The Teck-Hughes during the fiscal year ending August 31 realized a gross income of $5,512,033, the net earnings being $3,541,697. Construction of the new mill addition is making steady progress, the building being closed in and ready for the installation of machinery. It is expected to be completed by next May and will increase the present capacity of 950 tons to 1,250 per day. The main shaft of Wright Hargreaves is now down 2,400 ft. where a station has been cut. The grade of ore shows improvement with depth and, at the

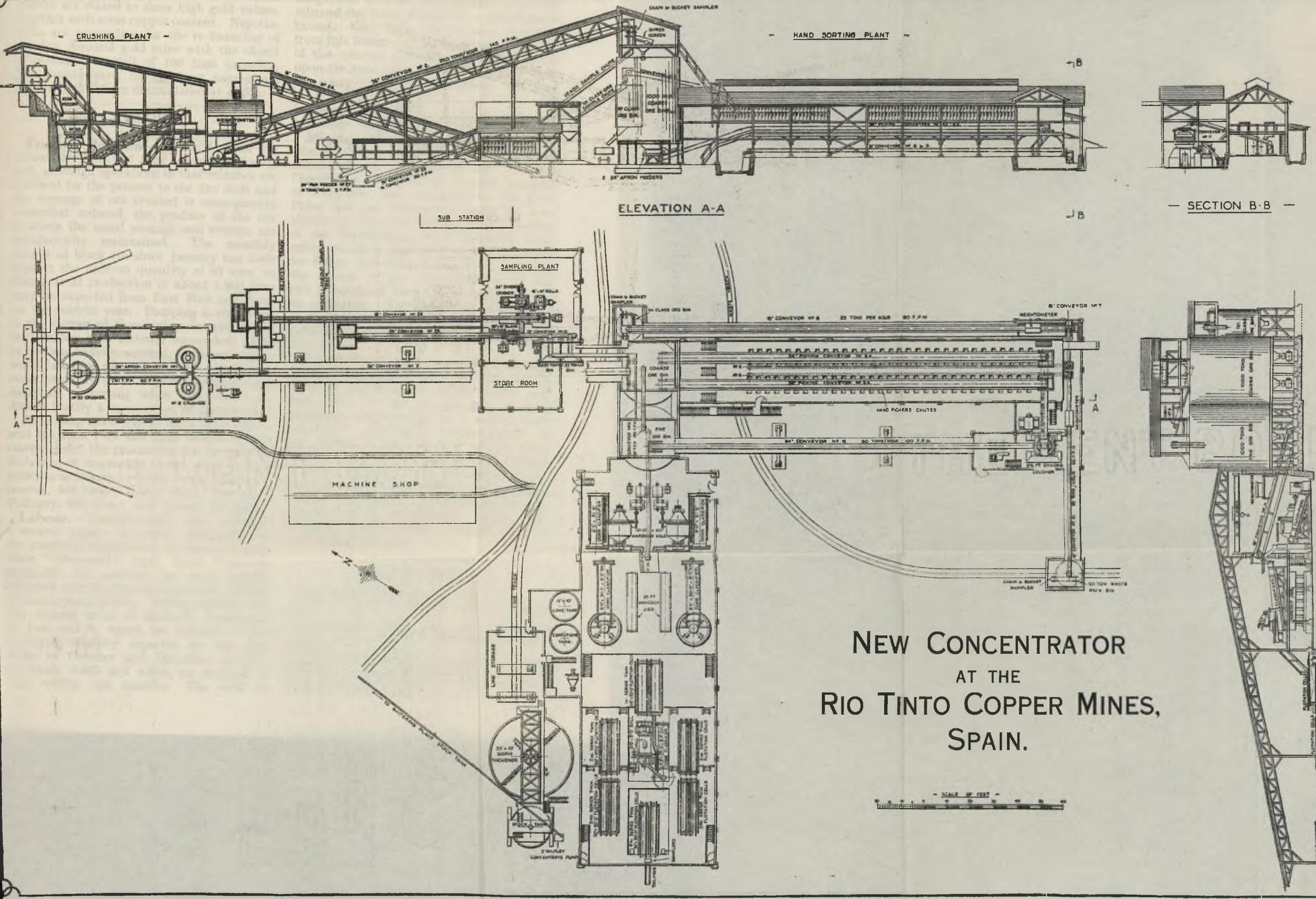
lowest level developed, a total of 2,400 ft. of ore has been opened up. Ore going to the mill is said to run better than $11 in gold to the ton. The Sylvanite has opened up a new vein on the 40 ft. level carrying $11 ore, the downward continuation of which has been proved. A large ore-body is being developed between the 1,500 and 1,750 ft. levels. Shaft sinking at the Kirkland Lake gold mine has been halted at the 4,375 ft. level, in order to devote attention to lateral work on the lower horizon. A merger has been affected between the Cheltonia Kirkland and the Swastika Kirkland, the new company being known as the Cheltonia-Swastika Mines, Ltd.

Sudbury. — International Nickel is curtailing its output and reducing its working forces. At the Frood mine the output has been reduced from 4,000 to 3,000 tons of ore per day, and production at the Creighton which has been on a basis of about 50,000 tons per month will also be lessened. At the Copper Cliff smelter, one of the four reverberatories has been closed down. Net profits of International Nickel for the first nine months of the current year were $9,897,836 as compared with $16,865,754 for the same period of last year. Net profits for the third quarter amounted to $2,013,961, as against $3,267,730 for the previous quarter. The smelter of the Falconbridge during the three months ending September handled 22,195 tons of ore, from which was produced 1,775,537 lb. of matte containing 1,040,697 lb. of nickel, and 459,787 lb. of copper. As the company's refinery in Norway cannot handle the supply of matte now on hand, smelter operations have been suspended for a period of 60 days. The Falconbridge has purchased the properties of the Sudbury Nickel and Copper Co., Ltd., a subsidiary of the Sudbury Basin, the consideration being 50,000 fully paid shares of the Falconbridge. The Treadwell Yukon will continue operations at the Errington mine despite adverse market conditions. Lateral work at the 1,500 ft. level has so far proved disappointing, but will nevertheless be continued with the hope of encountering commercial ore.

Rouyn.—The Noranda, in accordance with an agreement entered into with other copper producing companies, is curtailing its output of that metal. The capacity of the mill, however, will be maintained by the treatment of gold ore, supplies being drawn from a large gold ore-deposit carrying values from $12 to $15 per ton. It is understood that there is a sufficient gold mineralization available to keep the mill in operation on a 500 ton a day schedule for at least two years. The Siscoe gold mine is enlarging its mill and the addition is expected to be completed before the end of the year. The main shaft will be put down 150 ft. to a vertical depth of 600 ft. Underground work has revealed vein widths much in excess of those indicated by diamond drilling. The mill of the Granada gold mine during September and October handled an aggregate of 3,995 tons of ore with a recovery of approximately $63,000, or an average of $15·75 per ton. Underground development is making good progress and cross-cuts are being run at the 625 ft. level to cut promising veins shown on the surface. The Pandora is carrying an active diamond drill campaign in the course of which good gold values have been encountered.

Patricia District.—Operations at the Howey, the only producing gold mine in this district, have so far been unremunerative and the company is heavily in debt, rendering financial reorganization necessary. The success of the enterprise appears to be dependent upon the continuity of mineralization below the 1,000 ft. level, at which horizon it appears more uniform than on the upper levels. The Central Patricia, on which a considerable tonnage of commercial ore has been disclosed, remains closed down pending a re-arranging of finances. The Metals Development Company is carrying on active work on their property in the Woman Lake section, on which a shaft is down 100 ft. and recent discoveries of rich ore are reported. It is proposed to carry on active work during the winter. The Casey Mountain Operating Syndicate has obtained favourable results from diamond drilling on its property in the eastern section of the district and will install a mining plant.

Manitoba.—The mill of the Flin Flon is treating upwards of 2,000 tons of ore per day which will shortly be brought up to 3,500 tons. The first stage in the production of electrolytic zinc has been reached by putting the zinc roasters into operation. Coincidentally two copper roasters have been started and good progress towards production is being maintained. The calcines from the roasters are being bedded until the reverberatory furnace is ready to receive them. Underground operations at the Sherritt-Gordon have been temporarily



NEW CONCENTRATOR AT THE RIO TINTO COPPER MINES, SPAIN.

[To face p. 336.

suspended and a large number of miners employed have been released. Construction of the milling plant and the surface buildings continue to make good progress, with the expectation of beginning operations in January. New gold discoveries in the Copper Lake area a few miles east of Flin Flon have attracted much attention and a number of old claims have been restaked. Assays are stated to show high gold values, together with some copper content. Negotiations are proceeding for the re-financing of the San Antonia gold mine with the object of installing a mill of 100 tons capacity. The management having been encouraged by the high values encountered at depth.

CAMBORNE

December 5.

Present Position.—Of the Cornish tin mines East Pool and Agar alone is producing and, although operations in that instance are confined for the present to the day shift and the tonnage of ore crushed is consequently somewhat reduced, the produce of the ore is above the usual average and returns are satisfactorily maintained. The monthly output of black tin since January has been kept at the uniform quantity of 83 tons, so that a total production of about 1,000 tons may be expected from East Pool and Agar for the current year. Pumping is continued in the deeper of those mines in which production has been recently suspended, while in the less heavily-watered, shallower mines, water has been allowed to rise. In all cases steps have been taken to prevent unnecessary delay in re-starting when improved conditions justify a resumption of operations.

Reckoning 1,000 tons of black tin to represent the East Pool and Agar output for the current year, the production for the year to the dates of suspension of the other leading mines is as follows:—South Crofty, 630 tons; Geevor, 540 tons; Wheal Kitty, 351 tons; Polhigey, 256 tons; and Jantar, 230 tons.

Labour.—Unemployment has assumed a serious aspect, somewhat intensified by the continued importation of labourers from other "distressed" areas, South Wales in particular, for sewerage and water supply contracts now in progress, financially assisted by Government grants. Taking together the four mining areas of Redruth, Camborne, St. Just, and St. Agnes, the numbers of unemployed officially reported for the first weeks in October and December are respectively 2,632 and 4,053, an increase of 1,421 within two months. The total of 4,053 for the four mining areas is nearly a half of the official total for the whole of West and Mid-Cornwall. It is estimated that the present rate of unemployment pay in the four mining areas exceeds £250,000 per year! A much smaller sum would keep the suspended mines in full operation.

In former periods of acute depression, emigration to other mining lands generally relieved the home pressure to a considerable extent. Very little relief is now available from this source. True, the financial burden of the affected districts, instead of falling upon the local rates, is now distributed over the country as a national charge, but that is a small compensation for even the temporary suspension of an ancient and important industry.

Mining Development Scheme.—The scheme jointly prepared by a special committee of the councils of the Cornwall Chamber of Mines and the Cornish Institute of Engineers, and submitted to the Lord Privy Seal last February is under the consideration of the Non-Ferrous Sub-Committee of the Metalliferous Mines Advisory Committee recently appointed by the Secretary for Mines, and there is reason to hope that the appeal of the representatives of the two Institutions for a full investigation will be successful. The claims and the merits of the tin-mining industry in Cornwall are certainly as great as those of gold mining in Wales.

The scheme in question mainly deals with the development of the area lying to the north of the Roskears, South Crofty, and East Pool. It also includes two or three additional developments on a smaller scale elsewhere. Increasing unemployment in the mining districts renders all the more pressing the need for Government support to such a scheme; and a correlation of the interests of two Government departments, Labour and Mining, should be possible in such a way as to minimize "dole" disbursements while lending a helping hand to a struggling industry.

PERSONAL

John Davey is returning from Chile.

M. W. L. Dempster is returning from the Gold Coast.

B. Drinkwater is returning from South Africa.

Donald Gill is on his way home from Northern Rhodesia.

C. H. Lander, Director of Fuel Research at the Department of Scientific and Industrial Research, has been made an additional member of the Safety in Mines Research Board.

A. LEAVER has left for the Dutch West Indies.

N. E. ODELL is here from British Columbia and expects to be engaged on research work until next Spring.

WALTER PERRING is returning from Venezuela and Colombia.

C. R. PINDER is leaving for Victoria

J. C. RICHARDS is returning from Uganda.

A. W. ROSS is home from Burma.

R. W. SCOTT is proceeding from British Guiana to Ecuador.

JOHN SPIERS is home from South Africa.

M. H. THOMAS is returning from the Gold Coast.

K. S. TWITCHELL has left for Arabia.

R. J. WESTWOOD has left for Noranda.

L. A. MILLETT, who was manager in Greece for the Anglo-Greek Magnesite Co., Ltd., died on November 3 from blackwater fever at the age of 49. He had served with the company since 1922.

SIR OTTO BEIT died on December 7 at the age of 65. He was a member of the governing body of the Imperial College of Science and Technology and founded, among other scholarships, the fellowships for scientific research, tenable at the Imperial College, that bear his name. He will be remembered also for his munificent support of the Hostel scheme.

ERNEST OWEN COURTMAN died at his home at Surbiton on October 20 from heart failure at the age of 52. He graduated at the Royal School of Mines, in both metallurgy and mining. After spending some time on the Evenwood Colliery, Durham, he became a demonstrator in the Mining Department of the Royal School of Mines but, in 1900, he transferred to the staff of the Metallurgical Department, where he has since remained. For some years he commanded the Engineer Unit of the University of London Officers Training Corps and during the war he was Commandant of R.E. Schools of Instruction and, near its termination, he was attached to the General Staff of the London District. Late in 1919, Major Courtman rejoined the Metallurgical Department of the Royal School of Mines and was appointed Assistant Professor of Metallurgy (Ferrous Branch) and this position he held until his death. He was greatly interested in architectural subjects, and was awarded the University of London Diploma for Architecture.

JOHN WILLIAM EVANS died on November 16, aged 73. Educated at University College School, University College, and the Royal College of Science, Dr. Evans was called to the Bar in 1878, later becoming a demonstrator in the geological department of the Royal College of Science, only to relinquish this post to accompany an expedition to Brazil as geologist. On his return he was appointed State Geologist of Kathiawar, India, and from 1894 to 1898 he was a State Geologist in Mysore. In 1901–1902, Dr. Evans led an expedition into north-eastern Bolivia and on his return was appointed a special assistant at the Imperial Institute, where he remained for nine years. From 1906 to 1920 he was a lecturer at Birkbeck College and was attached to the geological department of the Royal College of Science, as lecturer in petrology, from 1912 until 1927. He was a member of the Colonial Survey Committee and of the Mineral Council of the Imperial Institute, a fellow of the Royal Society, and was awarded the C.B.E. in 1923. Up to his death he was chairman of the Geophysical Company, Ltd. and, in connexion therewith had recently done exploration work in Egypt, Syria, and South Africa.

TRADE PARAGRAPHS

Ruston and Hornsby, Ltd., of Lincoln, have sent us a folder which draws attention to the salient features of their new cold-starting horizontal oil engine which was recently described here.

British Jeffrey-Diamond, Ltd., of Wakefield, issue a leaflet describing the Blackett conveyor for underground handling of coal or ore, the applications of which are described in text and illustration.

Lead Industries Association, of 420, Lexington Avenue, New York, send us the first issue of a publication entitled *Lead* which contains a number of short illustrated articles pointing to uses of the metal.

Drayton Regulator and Instrument Co., Ltd., of West Drayton, Middlesex, issue an illustrated catalogue of their manufactures, which include self-operating regulators, water and air-operated regulators and electrically operated regulators for control of all sorts of process work.

The Leyland and Birmingham Rubber Co., Ltd., of Leyland, and Grand Buildings, Trafalgar Square, London, W.C. 2, in the November issue of their *Leyland Rubber Relay* have a brief article with some photographs showing installations of Leyland belts in certain of the nitrate properties in Chile.

Gardner-Denver Co., Ltd., of 3, Wilson Street, Drury Lane, London, W.C. 2, inform us that Mr. William B. Lawson has succeeded Mr. Ralph A. Scott as managing director of the Gardner-Denver Co., Ltd. Mr. Scott has returned fo America to take up the position of general sales manager of the Gardner-Denver Co.

Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, inform us that recently they have received orders for eight Ward Leonard equipments of considerable size, four of which are for Australia and four for Rhodesia. It is hoped to publish in these columns further details with regard to these contracts at a later date.

Bureau of Information on Nickel of the Mond Nickel Co., Ltd., of Imperial Chemical House, London, S.W. 1. issue a publication devoted to nickel in light aluminium alloys. This comprises articles on the " Y " alloy, by S. L. Archbutt, the " R.R. " group of alloys, by R. W. Harvey-Bailey, and the manufacture and application of both types of alloy, by W. C. Devereux.

Edgar Allen and Co., Ltd., of Imperial Steelworks, Sheffield, issue a booklet covering 29 pages, fully illustrated with photographs and drawings, describing their Stag tube-mills and giving details as to the making of the various parts and the purposes for which these machines can be used. A section is also devoted to the centra-drive for combination mills and tube mills.

Ruston-Bucyrus, Ltd., of Lincoln, issue a leaflet giving data such as may be required by excavator operators. This contains metrical equivalents and other useful memoranda such as weights of some common materials, angles of repose, and suction-dredge data, etc. They also send us a pamphlet drawing attention to the various uses to which their No. 4 excavator can be and has been put, which contains illustrations of typical contracting work.

Head, Wrightson, and Co., Ltd., of Stockton on Tees, issue a catalogue of elevators, belt conveyors and screens, and also a booklet describing the improved Impact screen which is one of the vibratory types. They also send us a booklet

devoted to Nissen stamp mills, which are sufficiently well known in general features to need no description here. The booklet gives very full particulars and photographs of a number of typical installations.

Samuel Osborn and Co., Ltd., of Clyde Steel Works, Sheffield, have put on the market a form of tool which, it is claimed, is an important advance on any of the existing types of tipped tools. Their S.O.B.V. " Solidend " tools consist of a solid piece of S.O.B.V. cutting alloy butt welded on to a high tensile steel shank. The welding is done by a special process, no cementation being used, but there is a complete fusion of the metals forming the weld which, it has been proved, is enormously strong.

Perrin's, Ltd., of 3, Central Buildings, Westminster, London, S.W. 1, have sent us a booklet devoted to autogene welded steel pipes and equipment. This describes the method of manufacture, the range of manufacture, the various types of joints employed, means for protection against corrosion, the economics of autogene, the transportation of pipes and the application of pipes. Among a great number of illustrations are included photographs showing the uses of these pipes in Nigerian tin mines and in connexion with a variety of hydro-electric undertakings.

Mining and Industrial Equipment, Ltd., of 11, Southampton Row, London, W.C. 1, report that new orders have been received for the following equipment: For England: One No. 00 Raymond pulverizer for dyes; one 3 ft. by 5 ft., type 39, Hum-mer electric screen for sand and gravel; one 4 ft. by 5 ft., type 39, 1 surface Hum-mer electric screen for red marl clay. For France: One No. 0000 Raymond pulverizer for powdered rice; one No. 00 Raymond pulverizer for litharge. For Rhodesia: Two 4 ft. by 5 ft., type 39, Hum-mer electric screens for copper ore fluxes.

C. H. Johnson and Sons, Ltd., of Smedley Road, Manchester, issue leaflets descriptive of their portable conveyors for all sorts of loading, unloading, and stacking uses, which are supplied complete with petrol engine or electric motor; their high-speed vibrating screening machine; and side-tipping trucks of $\frac{1}{3}$, $\frac{1}{2}$, and $\frac{3}{4}$ cu. yd. capacity respectively, for all rail gauges. Other products of this firm include both portable and fixed bucket elevators, permanent fixed conveyors, screening machines of other types than that mentioned, crushers and pulverizers, and hoists.

Engineering Specialists, Ltd., of 121, Kingsway, London, W.C. 2, send us a folder drawing attention to the Vee-Reg valve. The valve (or clack) has a cylindrical sliding guide part (containing triangular openings) that fits into the seat. The openings are arranged below the face of the valve (or clack) so that the valve face is protected. A rim protects the seat face. Consequently, as the valve is opened, there is no appreciable passage of steam until the faces are well apart, and when the steam does pass, it is deflected from the faces. In addition to this, the triangular openings ensure a fine control, which is another important characteristic of this valve.

British Aluminium Co., Ltd., of Adelaide House, King William Street, London, E.C. 4, issue particulars of an international competition for the development of the use of aluminium and its alloys, which has for its object the encouragement of the development of the aluminium industry and is being operated by the International Aluminium Bureau, of which the company is a member. The competition is divided into two sections for direct and indirect applications of the metal or its alloys. Full particulars of the conditions and the prizes offered can be obtained from the company or direct from the Bureau International de l'Aluminium, 23 bis Rue de Balzac, Paris, 8E.

Holman Bros., Ltd., of Camborne, Cornwall, have issued three new catalogues. Two of these deal with air compressors—the " S " type compressor which is a single-stage machine having a capacity of 350 cu. ft. per minute, which is claimed to be as economic in operation as a two-stage compressor, and the Hele-Shaw Beecham compressor which is marketed as a portable set of 80 cu. ft. capacity. The third catalogue alluded to describes the new Twingrip drill sharpener, which while it embodies the same principle of design as any form of drill sharpener, has been so modified and improved as to be easier to operate, and is faster and more efficient. The unique feature of this sharpener is that there are two operating pistons, one above and one below the jaws.

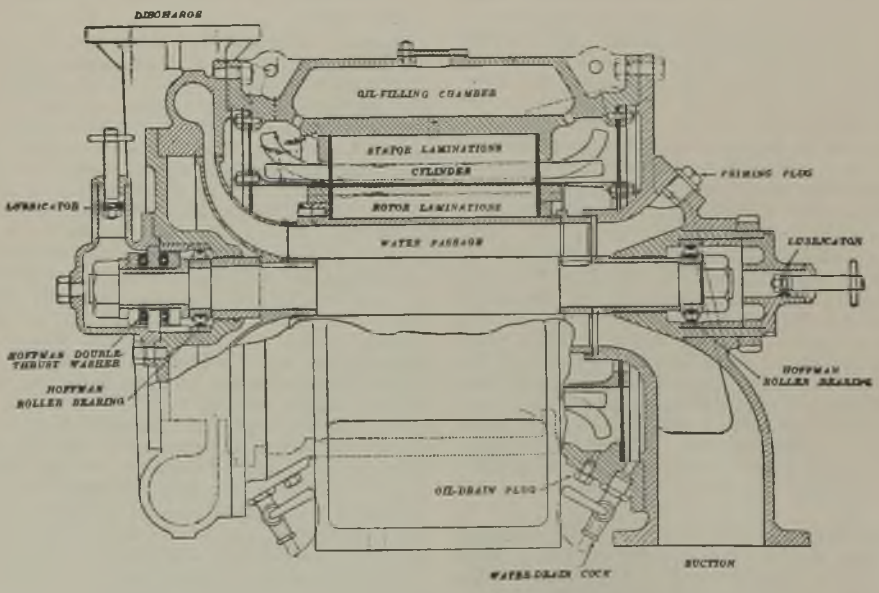
Hadfields, Ltd., of Sheffield, have issued a new booklet devoted to their Era 131 heat resisting steel for boiler plants operating at high temperatures. The need for this special steel has become evident with the advanced temperatures of modern steam practice. The special feature of this steel which distinguishes it from some of its predecessors is its amenability to manufacturing processes with almost the same facility as mild steel. At the same time it maintains a remarkable strength at temperatures of the order of 1,100° F. (590° C.). Although not possessing the same non-scaling properties of the Era/H.R. steels yet it only scales at about half the rate of ordinary steel for equal temperatures. The steel is supplied in castings of any form and also rolled bars, plates, sheets and wire, or cold rolled strip, and forgings of any form which is practicable in mild steel.

Samuel Fox and Co., Ltd., which is associated with the **United Steel Companies, Ltd.,** of 17, Westbourne Road, Sheffield, have issued a booklet setting forth the salient features of Fox " Rokbore " hollow mining drill steel which is rolled on a steel core. Comparing this with other types of hollow drill steel the makers suggest that those rolled on sand cores are liable to be eccentric and misshapen in the section of the hole, while the surface of the inner wall of the hole is liable to be rough and indented. Copper-core drill steels are said to be similarly disadvantageous although admittedly not so rough on the inner surface. On the other hand they claim for the steel-core drill that it is perfectly round, central, very smooth and clean. Photomicrographs are published indicating the type of fatigue which causes fracture resulting from the disadvantages alluded to in other types of drill steel. In developing the present steel the makers have paid particular attention to the cutting edge, the toughness, and to simplicity of heat treatment. Their steel is guaranteed to have sulphur and phosphorus combined content not exceeding 0·04%. Solid drill steel bars of the same quality are also available, and finished and sharpened hollow or solid drill steels can be supplied ready for use in a variety of bits, notably the double arc bit, rose bit, Z bit, chisel bit, double chisel bit, pointed bit, scoop bit,

and the common cross bit. Particulars of the tempers in which this steel is supplied and the appropriate heat treatment are added.

Electromersible Motors and Pumps, Ltd., of Abbey House, Westminster, London, S.W. 1, inform us that they have acquired the goodwill, drawings, patterns and data of Submersible Motors, Ltd. (in liquidation), together with the Reed Cooper patents relating to submersible motors and pumps, and have opened new works for the production of their patent submersible pumping equipments. These equipments embody the best features of both the other constructions, and are suitable for almost any working conditions. They also send us a catalogue describing the Reed Cooper Electromersible Pump, a sectional elevation of which is reproduced here. In principle it consists of a special electromotor in which the rotor is combined with the impeller of a centrifugal pump. The suction is placed at the opposite end of the motor and the water passes through the rotor and the protected stator windings. Overheating is thus prevented, the size of the motor is kept down and other difficulties inherent in previous pumps of this type are overcome. The drive is by means of an electric induction motor in which the usual cotton covered windings and laminae of the stator are enclosed in a watertight oil chamber, the rotor being free to revolve in water. This is particularly suitable for combination with a centrifugal pump in which the water to the pump is allowed to pass through the rotor. When the centrifugal pump is unsuitable for the required purpose other types of pump can be arranged to be used in conjunction with this patent submersible motor. Similar pumps having all the above essential features are also designed for deep-well or bore-hole pumping where a multi-stage centrifugal pump of small diameter is combined with a lengthy motor, also of small diameter and of the vertical shaft type. These long and thin combinations can be lowered down the bore-hole to hang on the delivery pipe. They are cheaper and more efficient than other means of pumping bore-holes, and are not dependent on the bore being straight as in other pumping arrangements. Motors internally cooled as above may be successfully used in any position above or below water or where the presence of corrosive or gassy atmospheres prohibits the use of motors of ordinary

Reed Cooper Bore-hole Pumps.



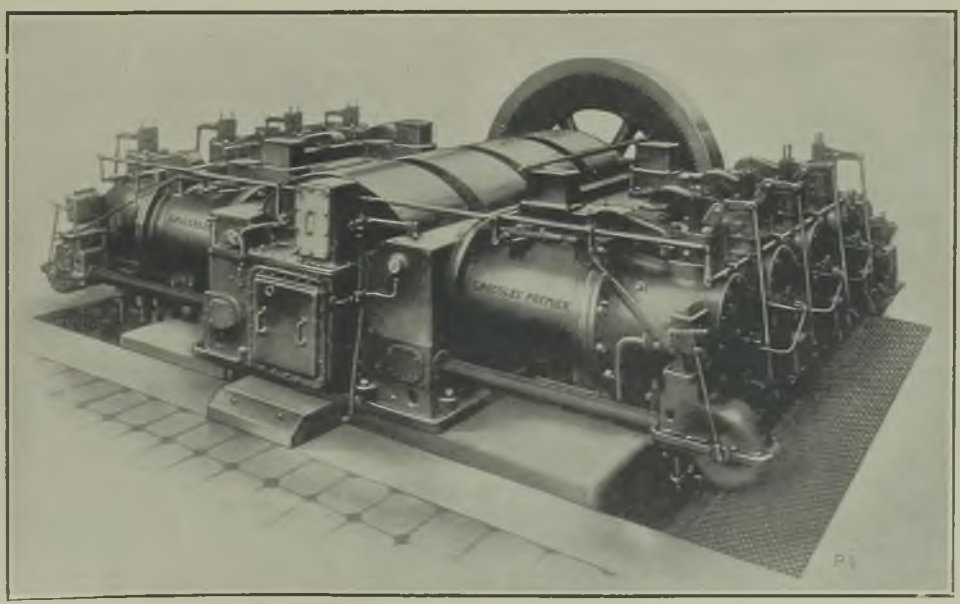
General Arrangement of Single-stage Electromersible Pump.

design. These machines will be found to compare most favourably as regards cost, weight, and dimensions with totally enclosed machines of ordinary design. The bore-hole pumps are made at present in two sizes, having respective outside diameters of 10¼ and 14⅝ in. for deliveries of 2,800 and 25,780 gallons per hour, the corresponding h.p. being 6 and 40. As examples of performance similar pumps supplied to the Admiralty each discharge 130 tons of water per hour at a 75 ft. head and weigh complete with motor only 950 lb. each. These pumps exceeded the guaranteed output by 30%.

THE CROSSLEY-PREMIER HORIZONTAL OIL ENGINE

The Premier Gas Engine Co., Ltd., of Sandiacre, nr. Nottingham, lately demonstrated one of their most recently developed horizontal oil engines, of which type the following is a brief description. The Crossley-Premier horizontal oil engine is a 4-cycle single-acting trunk piston airless injection unit and is made in standard types having 3, 4, 5, 6 or 8 cylinders, the cylinder heads with their liners being let into and attached to a common crankcase and crank chamber. The remarks contained herein apply more particularly to the latest unit—an 8 cylinder size and to the vis-a-vis unit of this type. In all the cylinder sizes, both vis-a-vis (i.e. an equal number of cylinders disposed on either side of the crank shaft horizontally) and side-by-side units are made. While both types have a great many spheres of application, both industrial and marine, the vis-a-vis has an advantage over the straight-line engine, particularly when considered from the point of view of torsional vibration. The short stiff shaft of the vis-a-vis keeps the engine well out of the range of dangerous critical speeds. The engines are cold starting units and no initial heating of jackets or of hot bulbs—for these, of course, are non-existent—is necessary. The largest unit made of this type of engine, which is the 8-cylinder vis-a-vis unit, is rated at 1,000 h.p. at 215–225 r.p.m. This engine has been extensively tested at the Company's works, and has proved not only extremely economical in fuel but also free from any vibration. The 1,000 h.p. unit has each of its 8 cylinders arranged four on either side of the common crankshaft. Each of these cylinders has a diameter of 18 in. and a stroke of 26 in. The drawing reproduced here shows a cross section of a typical engine.

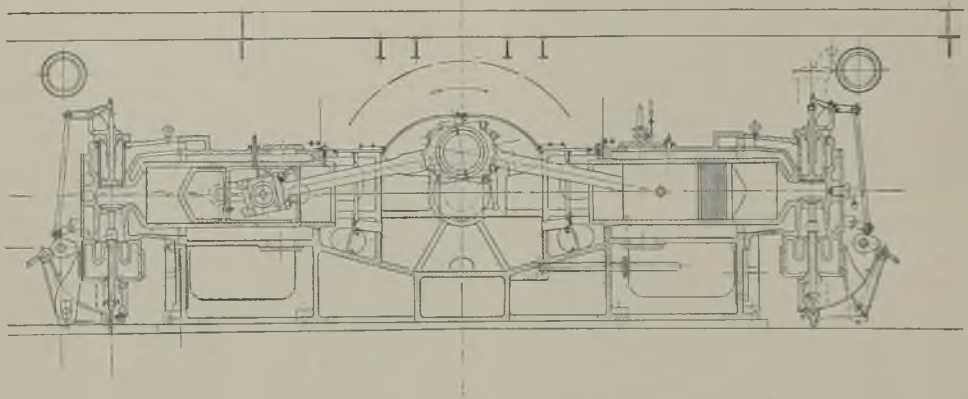
One of the most noteworthy features of this engine is its strong and solid construction. The cylinders, with their water jackets, liners, and breech ends, are strongly bolted to the machined surface of the bed-frame which forms as it were the central section of the engine. It thus bears an entirely different, and in many respects superior, relationship to the complete set-up of the engine, than that which is borne by the crank chamber of an ordinary vertical direct acting engine. The cylinder structures are supported at their back ends on planed feet which are carried by a sole plate, this arrangement relieving the cylinders of all overhanging strains. As has been mentioned, the engine is a 4-cycle unit. Some of the greatest criticisms which have been advanced against this type of unit when vertical have been the size of valve gear, the arrangement of rocker arms, camshaft, and in some cases push rods. With the horizontal engine a great point is to be made of the fact that these troubles are very largely eliminated. As the drawing shows, in the vis-a-vis engine the arrangement of valves is an extremely compact as well as an economical one. Air inlet and exhaust valves are arranged vertically in the cylinder breech end, a special portion of the casting being arranged for their housing. The air inlet valve is operated from the camshaft by means of a push rod while the exhaust valve is controlled by a rocker arm. The inlet valve is vertically above the exhaust valve and one cam only is



Crossley-Premier 1,000 h.p. Vis-a-Vis Horizontal Diesel Engine.

required for both valves. The exhaust valve can be withdrawn from the same opening as the inlet valve. Both inlet and exhaust valves have an "economical" construction in that each valve is provided with two springs, either of which of itself is sufficiently strong to close the valve in question, and thus in the event of one spring breaking it can be taken out and replaced without any disturbance occurring to the running of the engine, a very important point for certain types of both land and marine service.

Starting is effected by compressed air at 250 lb. per sq. inch pressure stored in a special receiver and admitted to two or four of the cylinders according to the size of the engine, there being for this purpose non-return valves connected by suitable piping to a cam-operated air-distribution valve. The main supply of compressed air is controlled by means of a hand-operated stop valve so that when the engine is in proper position for starting, starting itself is not only simple but prompt in action. Compressed air is, of course, supplied by the usual means of separately driven compressors, driven either by electricity or by petrol engine according to requirements. This, then, is a further simplification of the ordinary vertical 4-cycle engine, where unless a special rotary valve arrangement is effected as on some of the more modern types of engine, it is necessary to have four valves in each cylinder head—starting air, air inlet, fuel, and exhaust. This may tend easily to make for a complicated cylinder head casting, but the Crossley-Premier horizontal engine, as is well seen, eliminates much of this and the engine has all the valve simplicity of the 2-cycle with none of the disadvantages of this latter type. Airless injection is a further advantage in this compactness. The fuel-oil pumps are themselves arranged at the back of the cylinders in a convenient position above the camshaft and they are operated by means of the specially designed cams. The cams which operate the pumps are secured to a disc arranged between and mounted on the shaft in such a way that pump timing adjustment is readily obtained. Cam rollers are fitted in the free end of a lever which by means of a toe presses against the lower end of a guided sliding piece, the upper end pressing against the lower end of the pump plunger. The plunger is thus operated by direct central thrust, and is not subjected to any lateral force. The lever fulcrum has very little pressure to withstand and acts only as a guide. The cams dip into an oil bath and convey lubricating oil to the working parts. Hand levers are provided so that each pump can be operated by hand for priming. A Crossley Precision Sprayer is fitted to each cylinder and arranged on the centre line at the back of the breech end. The Sprayer valve controlling the fuel admission is held on its seating by a spring and is opened by the pressure of fuel oil from the pump serving that cylinder. Each time the sprayer valve lifts, the fuel passes through a multi-jet nozzle and enters the combustion chamber thoroughly atomized. There is no dribbling, the cut-off being sharp each time, and this improves the economy and cleanliness of the engine in working. A filter or strainer is interposed between the pump and the sprayer valve, to remove finally all trace of foreign matter from the fuel oil. The mesh of this is finer than the smallest hole in the nozzle. The sprayer valve and nozzle are made of tool steel accurately ground to size and fitted into a steel body bolted in the centre of the breech end. The sprayer body is provided with a metal to metal joint to afford easy removal. Hand relief valves are provided by means of which all the fuel oil can be by-passed, if desired. The cam-shaft runs along the end of each "row" of cylinders. Lubricating oil to the pistons and small ends is supplied from double plunger forced-feed lubricators which are driven by the cam-shaft. In the case of the piston, there is only one feed on the liner top and the oil gravitates down thus ensuring very efficient lubrication. The main bearings and big-ends are lubricated from a tank at one end of the bed-plate the oil being delivered through the crankshaft. The surplus is by-passed over the governor and gears and down into the side shaft well.



Cross-section of Crossley-Premier Vis-a-Vis Diesel Engine.

The connecting rods are made of mild steel open-hearth forgings, machined and polished all over, and are fitted with marine type bearings at both ends. The bolts securing the bearings are abnormally large, with a high factor of safety, are made of very tough material, and are heat treated. The crank-pin bearings are of cast steel, lined with best quality white metal, and made adjustable. The piston pin bearings are likewise adjustable and made of best quality phosphor bronze. Each piston is of high grade cast-iron, and of extra length to give ample wearing surface. They are fitted with a sufficient number of rings of special type to ensure no leakage of gases past the rings. The pistons themselves are carefully

bedded to the cylinders. The piston pin is made of open-hearth mild steel, hardened and accurately ground to size, and securely fitted in the piston. This pin is of large dimensions to give ample bearing area, so that the wear shall be the minimum to avoid all tendency for knocking to occur.

With regard to the performance of the Crossley-Premier engine it is interesting to note that a comprehensive series of tests was carried out recently on a 6-cylinder 750 b.h.p. type No. 6 engine by Mr. W. A. Tookey. These tests were both output and fuel consumption tests and were carried out with different types of fuel, and at the rated h.p. of the engine a fuel consumption of 0·38 lb. per h.p. per hour was registered with a brake M.E.P. of 69 lb. per sq. in. The lubricating oil consumption works out at only $11\frac{1}{4}$ lb. during $15\frac{1}{4}$ hours which represents 0·738 lb. of oil per hour which is equivalent to two-thirds of a pint. One gallon of lubricating oil would at this rate suffice for 12·2 engine hours or $12{\cdot}2 \times 750 = 9{,}150$ b.h.p. hours. Throughout the whole series of trials the colour of the exhaust gas showed that the combustion conditions were entirely satisfactory and exhaust gas analysis confirm this fact. As far as accessibility is concerned, a special test on the removal of a piston from this 750 b.h.p. set showed that the time between commencing the removal and the placing of the piston on the ground in front of the engine ready for inspection occupied only $16\frac{1}{2}$ minutes.

METAL MARKETS

Copper.—Quite a little " boom " was witnessed on this market during November, owing to the decision of the majority of the world's producers to curtail output by some 20,000 tons a month. Although it was not certain whether this measure would secure the approval of the American authorities, who might see in such concerted action a violation of the anti-Trust laws, and despite the fact that surplus stocks of copper remained at an unwieldy figure, quotations moved up sharply, electrolytic being advanced from 9·50 cents to 12 cents per lb. f.a.s. by the middle of the month, Standard quotations in London responding in sympathy. The advance was accentuated by the fact that Copper Exporters Inc. adopted their usual tactics of doling out supplies of copper to consumers in a parsimonious fashion. Subsequently, however, demand fell away and easier conditions prevailed, electrolytic metal being offered by outside interests at down to 11 cents.

Average price of Cash Standard Copper: November, 1930, £46 3s. 8d.; October, 1930, £43 1s. 5d.; November, 1929, £69 8s. 4d.; October, 1929, £72 17s. 2d.

Tin.—Prices fluctuated within moderate limits during the past month but the tendency, on balance, was very steady. The metal looked cheap, but on the other hand there was very little in the position to encourage the belief that prices were likely to advance very heavily in the immediate future, and sentiment accordingly remained subdued. Demand from consumers was dull and visible supplies were large enough to obviate the possibility of any scarcity of metal occurring for a long time to come. There has been quite a substantial curtailment in output, but it looks as if production may have to be cut down still further if the market is not to remain unstable unless consumption revives unexpectedly. Whether this curtailment can be effected by voluntary means or whether it will be enforced by the grim pressure of economic laws only time can show.

Average price of Cash Standard Tin: November, 1930, £113 11s. 10d.; October, 1930, £117 11s. 1d.; November, 1929, £180 13s. 7d.; October, 1929, £190 17s. 7d.

Lead.—The London lead market was fairly firm during November and prices recorded a moderate gain. The strength of values was doubtless connected to some extent with the improvement in the copper market, for the non-ferrous metals are inevitably affected sympathetically by each other. The actual lead position, however, has not appreciably improved. Demand is rather restricted, there is plenty of available metal and probably but for the existence of the Lead Producers' Association prices would rule at a lower level than is actually the case.

Average mean price of soft foreign lead: November, 1930, £15 18s. 7d.; October, 1930, £15 14s. 2d.; November, 1929, £21 12s. 7d.; October, 1929, £23 4s. 9d.

Spelter.—Prices had a rather uncertain aspect during the past month, but on balance reflected a decline. The market position was not particularly hopeful, as there were large surplus stocks and demand from consumers was poor. A fresh meeting took place on the Continent towards the close of November regarding the proposed re-establishment of the International Zinc Cartel, but for some days previous to the meeting the outlook as regards an agreement being reached was not believed to be favourable, and as a matter of fact the meeting turned out to be a failure. There is quite a possibility that the idea of re-establishing the Cartel may now be abandoned.

Average mean price of spelter: November, 1930, £14 19s. 5d.; October, 1930, £14 13s. 9d.; November, 1929, £21 2s.; October, 1929, £23 2s. 6d.

Iron and Steel.—The Cleveland pig-iron industry, on the basis of its restricted production, appeared to be in a fairly sound position during November, as it was disposing of its current output without difficulty. In other producing districts, however, conditions were not so favourable, and Midland makers " cut " prices by 2s. 6d. per ton in an effort to stimulate demand and to combat the competition of imported iron. In Scotland, the blast-furnaces are likely to be affected by the coal stoppage in that area. Meanwhile, the available indications portend an intensification of international competition in pig-iron, as Continental makers of foundry grades have resumed freedom of action. Cleveland No. 3 foundry g.m.b. remained at 63s. 6d. minimum. Hematite continued to be a fairly satisfactory market, with East Coast Mixed Numbers steady around 71s. The position of the British steelworks was discouraging owing to paucity of orders, but on the Continent a revival of demand was witnessed which pushed Continental export prices up substantially from the lowest levels recently touched. It is not yet certain whether the Continental Raw Steel Cartel will be renewed for next year.

Iron Ore.—Business remains practically non-existent and prices have eased further, best Bilbao rubio being only about 16s. per ton c.i.f. for prompt cargoes.

Antimony.—At the close of the month English regulus was quoted at from £36 to £46 per ton. There was but little demand for Chinese regulus,

LONDON DAILY METAL PRICES

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

	COPPER.				TIN.		ZINC (Spelter).	LEAD.		SILVER.		GOLD.
	STANDARD.		ELECTRO-LYTIC.	BEST SELECTED.				SOFT FOREIGN.	ENGLISH.			
	Cash.	3 Months.			Cash.	3 Months.				Cash.	Forward.	
Nov.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	s. d.
11	44 10 7½	44 13 1½	45 15 0	44 10 0	111 11 3	112 18 9	14 10 0	15 11 3	17 0 0	16⅝	16½	85 1½
12	45 1 3	45 3 9	47 15 0	—	110 8 9	111 16 3	14 13 9	15 8 9	17 0 0	16⅞	16⅞	85 0½
13	49 6 3	49 8 9	51 10 0	—	115 2 6	116 12 6	14 18 9	16 0 0	17 10 0	16⅛	16⅛	85 0½
14	50 16 3	50 16 3	53 15 0	52 0 0	116 16 3	118 3 9	14 18 9	16 13 9	18 0 0	16⅛	16⅛	85 1
17	49 13 1½	49 13 1½	53 0 0	—	115 1 3	116 8 9	15 6 3	16 16 3	18 5 0	16⅛	16⅝	85 1½
18	47 13 9	47 13 9	50 15 0	49 0 0	113 6 3	114 11 3	14 16 3	15 17 6	17 5 0	16⅜	16½	85 1
19	46 1 3	46 1 3	50 10 0	—	113 6 3	114 8 9	14 11 3	16 2 6	17 10 0	16⅜	16⅜	85 1
20	45 9 4½	45 11 10½	50 0 0	—	116 2 6	117 7 6	14 15 0	16 1 3	17 10 0	16⅛	16⅜	85 1
21	46 6 3	46 6 3	52 5 0	48 5 0	114 16 3	116 3 9	14 12 6	15 16 3	17 5 0	16⅜	16½	85 1½
24	47 16 3	47 16 3	52 5 0	—	113 18 9	114 18 9	14 13 9	15 18 9	17 5 0	16⅜	16⅜	85 1½
25	47 6 3	47 8 9	52 5 0	48 10 0	113 18 9	115 6 3	14 7 6	16 1 3	17 10 0	16½	16⅜	85 1⅜
26	47 11 3	47 13 9	52 0 0	—	114 3 9	115 8 9	14 3 9	16 1 3	17 10 0	16½	16⅜	85 1⅜
27	47 11 3	47 13 9	52 0 0	—	114 1 3	115 8 9	14 6 3	16 0 0	17 10 0	16⅝	16⅞	85 1⅜
28	47 0 7½	47 0 7½	52 0 0	48 10 0	114 18 9	116 2 6	14 6 3	16 3 9	17 10 0	16⅝	16⅝	85 1⅜
Dec.												
1	48 18 1½	48 18 1½	52 5 0	—	114 18 9	116 3 9	14 6 3	15 17 6	17 5 0	16½	16⅝	85 1⅜
2	50 8 9	50 8 9	55 15 0	52 0 0	114 6 3	115 11 3	14 8 9	15 17 6	17 5 0	16⅜	16	85 2
3	49 5 7½	49 5 7½	55 5 0	—	114 3 9	115 8 9	14 3 9	15 15 0	17 5 0	16⅜	16⅛	85 1⅜
4	48 18 9	48 16 10½	53 10 0	—	112 16 3	114 3 9	14 0 0	15 17 6	17 5 0	16	15⅞	85 1⅜
5	48 1 3	48 1 3	52 15 0	49 10 0	113 1 3	114 6 3	13 15 0	15 16 3	17 5 0	15⅞	15⅞	85 1⅜
8	47 6 10½	47 6 10½	51 15 0	—	112 6 3	113 11 3	13 15 0	15 11 3	17 0 0	15⅛	15⅝	85 1⅛
9	46 15 7½	46 15 7½	51 10 0	48 5 0	111 13 9	112 18 9	13 16 3	15 8 9	17 0 0	15⅛	15⅛	85 1⅛
10	46 13 1½	46 8 9	51 0 0	—	111 13 9	113 1 3	13 16 3	15 7 6	16 15 0	15⅛	15⅛	85 1⅛

which was priced between £25 and £26 ex warehouse for spot and £23 to £23 10s. c.i.f. for shipment from China.

ARSENIC.—The scarcity of Cornish arsenic has become more acute and prices are now largely nominal at about £18 10s. to £19 per ton f.o.r. mines. Mexican is offering at £18 c.i.f.

BISMUTH.—In view of a better consuming demand and less outside competition the Trust has advanced its price to 5s. per lb. for 5 cwt. lots and over.

CADMIUM.—Early in November further easiness in prices was seen, but at the lower level improved business developed and the market became steadier at about 1s. 10d. per lb.

COBALT METAL.—Only a poor demand is in evidence, but the official price remains at 10s. per lb.

COBALT OXIDES.—Quotations are without alteration at 8s. per lb. for black and 8s. 10d. for grey.

CHROMIUM METAL.—About 2s. 7d. per lb. is named for ordinary commercial quality metal.

TANTALUM.—In the absence of demand prices are nominally unaltered at £40 to £50 per lb.

PLATINUM.—Producers having agreed to maintain prices at £6 10s. to £7 per oz. according to quantity, confidence has been restored in some measure and a very fair business has been done between those figures.

PALLADIUM.—This market is quietly steady at £3 10s. to £4 per oz.

IRIDIUM.—Only a limited inquiry is received, quotations being unchanged at £37 to £39 per oz. for sponge and powder.

OSMIUM.—Supplies are none too plentiful and the tone keeps fairly firm, with quotations steady at £16 to £16 10s. per oz.

TELLURIUM.—There is nothing moving here and quotations are quite nominal at 10s. to 12s. 6d. per lb.

SELENIUM.—A steady business continues in 99% black powder at the unaltered price of 7s. 8d. to 7s. 9d. per lb. ex warehouse.

MANGANESE ORE.—Business has been negligible for weeks past, and there seems little prospect of any early revival. Washed Caucasian ore is now obtainable at under 11½d. per unit c.i.f., but for best Indian about 1s. 0½d. to 1s. 1d. per unit is asked.

ALUMINIUM.—There has not been any appreciable expansion in demand since the reduction in prices reported in our last issue, actual consumption being slow. Many manufacturers have stocks and some deliveries against 1930 contracts have been carried forward into 1931. Prices remain at £85, less 2%, delivered, for ingots and bars.

SULPHATE OF COPPER.—Values of this commodity have firmed up a little in sympathy with the recovery in copper prices, current quotations being about £21 10s. to £22, less 5%, for English material.

NICKEL.—Only a quiet demand is in evidence, but prices are steady at £170 to £175 per ton, according to quantity.

CHROME ORE.—Business is none too brisk, and current quotations may be called about 77s. 6d. to 80s. per ton c.i.f. for good 48% ores.

QUICKSILVER.—Hardly any enquiry is forthcoming, and prices are easier at about £22 7s. 6d. to £22 10s. per bottle, full terms, for spot material.

TUNGSTEN ORE.—The absence of buying interest remains complete and no bids have been received at any price. Sellers are now offering forward shipment from China at about 16s. to 16s. 6d. per unit c.i.f., whilst other grades might be had slightly cheaper.

MOLYBDENUM ORE.—Contract quantities remain at 35s. 6d. per unit c.i.f., but small parcels are still offering in the neighbourhood of 32s. 6d. to 33s. per unit.

GRAPHITE.—There is no change to report in this market, quotations remaining at about £25 to £27 per ton c.i.f. for good 85 to 90% raw Madagascar flake and £24 to £26 c.i.f. for 90% Ceylon lumps.

SILVER.—Throughout November this market has worn a very quiet appearance and price-movements have been within very narrow limits. On November 1 spot bars stood at 16 9/16d., and with a little Chinese support improved to 16¾d. on November 15. In the second half of the month there was hardly any interest shown and prices receded somewhat, spot bars closing at 16 5/16d. on November 29.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
November, 1929	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
November	844,038	40,715	884,753

TRANSVAAL GOLD OUTPUTS.

	October.		November.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	92,600	£147,873	88,500	£137,892
City Deep	98,500	26,391	95,000	25,057
Cons. Main Reef	63,000	22,290	65,000	22,501
Crown Mines	258,000	80,288	245,000	76,978
D'rb'n Roodepoort Deep	46,000	15,133	46,000	14,939
East Rand P.M.	157,000	42,093	153,000	40,903
Geduld	86,000	27,520	83,000	26,527
Geldenhuis Deep	71,100	16,212	70,000	15,589
Glynn's Lydenburg	6,000	2,029	5,700	2,161
Government G.M. Areas	211,000	£412,645	196,000	£380,514
Kleinfontein	51,300	11,106	50,600	10,973
Langlaagte Estate	84,000	£117,343	78,000	£112,184
Luipaard's Vlei	32,000	8,189	31,000	7,883
Meyer and Charlton	18,300	£18,339	17,800	£17,812
Modderfontein New	166,000	73,488	160,000	69,692
Modderfontein B	71,500	24,728	69,000	23,483
Modderfontein Deep	45,900	23,832	42,800	22,217
Modderfontein East	72,500	20,724	68,500	20,145
New State Areas	82,000	£171,204	76,000	£162,277
Nourse	68,000	19,869	66,500	19,575
Randfontein	221,000	£246,612	213,000	£239,386
Robinson Deep	95,400	27,995	97,000	27,570
Rose Deep	64,500	13,742	62,000	13,210
Simmer and Jack	81,600	22,103	77,800	21,993
Springs	75,500	£154,391	66,300	£140,386
Sub Nigel	31,000	27,905	30,900	27,668
Transvaal G.M. Estates	15,280	5,122	14,900	4,851
Van Ryn	42,500	£42,186	41,000	£41,142
Van Ryn Deep	68,000	£109,632	64,000	£102,096
West Rand Consolidated	93,000	£107,981	91,500	£106,503
West Springs	71,600	£79,721	68,800	£76,542
Witw'tersr'nd (Knights)	56,500	£52,334	55,000	£50,167
Witwatersrand Deep	44,500	13,983	39,200	12,822

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.	£
August, 1929	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	2,653,250	28 5	19 8	8 9	1,160,430
October	—	—	—	—	1,212,822

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
November 30, 1929	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
November 30	205,030	13,973	4,748	223,751

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	45,006
November	47,435	47,705	46,219	—
December	49,208	44,772	46,829	—

RHODESIAN GOLD OUTPUTS.

	October.		November.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	24,400	10,630	24,400	10,609
Globe and Phœnix	6,039	5,103	6,013	5,031
Lonely Reef	6,300	3,802	6,200	3,650
Luiri Gold	1,506	£2,842	1,547	£3,707
Rezende	6,400	2,700	6,400	2,680
Sherwood Star	5,000	£12,852	4,400	£11,520
Wanderer Consolidated	15,900	4,102	15,400	3,862

WEST AFRICAN GOLD OUTPUTS.

	October.		November.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	—	—	—	—
Ashanti Goldfields	11,390	13,238	11,388	13,534
Taquah and Abosso	10,010	£16,012	10,159	£16,135

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.
	Oz.	Oz.	Oz.
November, 1929	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	1,992	429
October	39,687	—	—
November	33,708	—	—

AUSTRALASIAN GOLD OUTPUTS.

	October.		November.	
	Tons	Value £	Tons.	Value £
Associated G.M. (W.A.)	6,195	8,868	5,000	8,368
Blackwater (N.Z.)	—	—	3,450	4,766
Boulder Persev'ce (W.A.)	7,404	15,393	7,070	15,506
Grt. Boulder Pro. (W.A.)	9,851	23,393	10,213	24,133
Lake View & Star (W.A.)	6,781	19,481	—	—
Sons of Gwalia (W.A.)	13,648	14,694	12,058	15,607
South Kalgurli (W.A.)	8,594	15,790	8,261	14,994
Waihi (N.Z.)	17,235‡	{ 5,834* / 36,672†	17,654§	{ 6,148* / 32,111†

* Oz. gold. † Oz. silver. ‡ To October 18. § To Nov. 15.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	October.		November.	
	Tons Ore	Total Oz.	Tons Ore	Total Oz.
Balaghat	3,300	1,950	3,500	2,312
Champion Reef	8,760	5,861	8,465	5,858
Mysore	17,969	9,694	17,403	11,600
Nundydroog	11,598	7,585	11,502	7,049
Ooregum	13,500	5,734	12,750	5,829

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	October.		November.	
	Tons	Value £	Tons	Value £
Chosen Corp. (Korea)	10,270	14,070	9,600	12,638
Frontino & Bolivia (C'lbia)	2,570	10,070	2,550	10,595
Lena (Siberia)	—	—	—	—
Lydenburg Plat. (Trans.)	4,250	1,062*p*	4,000	988*p*
Marmajito (Colombia)	1,010	5,941	1,000	5,652
Fresnillo	95,598	4,675*d*	—	—
Onverwacht Platinum	—	—	—	—
Oriental Cons. (Korea)	—	81,315*d*	—	86,000*d*
St. John del Rey (Brazil)	—	41,000	—	40,000
Santa Gertrudis (Mexico)	47,619	87,521*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	4,812
June	5,590	December	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	Sept.	Oct.	Nov.
Aver Hitam	—	59½	65½
Batu Caves	27	—	—
Changkat	—	50	55
Chenderiang	—	—	—
Gopeng	71½	65	65½
Hongkong Tin	110	77	63
Idris Hydraulic	23¾	25½	29¾
Ipoh	—	40½	48½
Jelapang	—	—	—
Kampar Malaya	—	86	80
Kampong Lanjut	86	158	110
Kamunting	98¾	—	—
Kent (F.M.S.)	36	39	40
Kepong	—	38	—
Kinta	21	27	33
Kinta Kellas	—	23¾	35¾
Kuala Kampar	40	105	100
Kundang	—	—	—
Lahat	—	—	20½
Larut Tinfields	—	—	—
Malaya Consolidated	72½	75½	53½
Malayan Tin	—	125	131
Meru	12	13	15
Pahang	225¾	225½	255¾
Penawat	75¾	226½	74½
Pengkalen	71½	65½	62½
Petaling	131	234	127
Rahman	59½	59½	53½
Rambutan	9	9½	9
Rantau	—	—	—
Rawang	48	90	100
Rawang Concessions	30	70	55
Renong	—	37	53
Selayang	—	—	—
Southern Malayan	—	—	223½
Southern Perak	—	29¾	23¾
Southern Tronoh	—	59	51
Sungei Besi	—	39	39
Sungei Kinta	—	22	31½
Sungei Way	—	83½	107½
Taiping	—	—	—
Tanjong	46	—	—
Teja Malaya	23	29½	26¾
Tekka	32	36	33
Tekka-Taiping	40½	41½	30
Temoh	—	—	—
Tronoh	—	108	96

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Sept.	Oct.	Nov.
Amari	—	—	—
Anglo-Nigerian	46	55½	36½
Associated Tin Mines	80	130	200
Baba River	3	7	7
Batura Monguna	2½	2½	3½
Bisichi	40	40	40
Daffo	11	16	—
Ex-Lands	—	55*	—
Filani	10½	—	4½
Jantar	15	15	—
Jos	19½	27½	28½
Juga Valley	6	6	17
Junction	—	—	—
Kaduna Syndicate	13	13	—
Kaduna Prospectors	13	13	—
Kassa	20½	21	12½
London Tin	80	220	75
Lower Bisichi	10½	8½	—
Naraguta	—	—	—
Naraguta Durumi	—	—	—
Naraguta Extended	—	—	—
Naraguta Karama	—	—	—
Naraguta Korot	—	—	—
Nigerian Consolidated	14	14	14
Offin River	3	4½	3½
Ribon Valley	15½	18	10¾
South Bukeru Areas	—	—	—
Tin Fields	—	—	—
Tin Properties	6	6	8
United Tin Areas	28	28	19
Yarde Kerri	12	15	10

* Output for 3 months.

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Sept.	Oct.	Nov.
Anglo-Burma (Burma)	37	38½	36¾
Aramayo Mines (Bolivia)	208	171	199
Bangrin (Siam)	107	96½	89
Consolidated Tin Mines (Burma)	176	130	118
East Pool (Cornwall)	82¾	82¼	37¾
Fabulosa (Bolivia)	130	181	163
Geevor (Cornwall)	32	45	—
Jantar (Cornwall)	22¾	—	—
Kagera (Uganda)	28	28	28
Malaysiam Tin	—	20¾	20¾
Northern Tavoy	—	—	—
Patino	1,309	—	—
Polhigey (Cornwall)	25	18¾	—
San Finx (Spain)	32½*	31½*	—
Siamese Tin (Siam)	—	—	—
South Crofty (Cornwall)	63¾	65	57½
Tavoy Tin (Burma)	—	64	—
Theindaw (Burma)	—	—	—
Tongkah Harbour (Siam)	90	93	53
Toyo (Japan)	59½	60½	86½
Wheal Kitty (Cornwall)	38	—	—
Zaaiplaats	30	—	—

* Tin and Wolfram.

COPPER, LEAD, AND ZINC OUTPUTS.

		Oct.	Nov.
Broken Hill South	Tons lead conc.	6,076	3,570
	Tons zinc conc.	—	2,656
Burma Corporation	Tons refined lead	6,420	6,420
	Oz. refined silver	560,000	571,000
Bwana M'Kubwa	Tons copper oxide	651	556
Electrolytic Zinc	Tons zinc	4,210*	4,171‡
Indian Copper	Tons copper	298	321
Messina	Tons copper	697	738
Mount Lyell	Tons concentrates	3,937	3,922
North Broken Hill	Tons lead conc.	5,770	—
	Tons zinc conc.	—	—
Poderosa	Tons copper ore	686	628
Rhodesia Broken Hill	Tons lead	—	—
	Tons slab zinc	1,360	1,300
San Francisco Mexico	Tons lead conc.	4,429	4,080
	Tons zinc conc.	4,242	4,165
Sulphide Corporation	Tons lead conc.	2,035§	1,995†
	Tons zinc conc.	2,789§	2,625†
Tetiuhe	Tons lead conc.	1,241	—
	Tons zinc conc.	2,523	—
Trepca	Tons lead conc.	—	3,570
	Tons zinc conc.	—	2,656
Zinc Corporation	Tons lead conc.	5,793	—
	Tons zinc conc.	3,721	—

† Four weeks to Nov. 15. ‡ Four weeks to Nov. 12.
* Four weeks to Oct. 15. § Four weeks to Oct. 18.

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

		Sept.	October.
Iron Ore	Tons	227,557	278,637
Manganese Ore	Tons	7,377	11,958
Iron and Steel	Tons	223,829	264,480
Copper and Iron Pyrites	Tons	14,949	16,433
Copper Ore, Matte, and Prec.	Tons	3,227	3,758
Copper Metal	Tons	16,429	19,209
Tin Concentrate	Tons	5,196	4,969
Tin Metal	Tons	720	320
Lead Pig and Sheet	Tons	32,348	28,041
Zinc (Spelter)	Tons	7,353	10,223
Zinc Sheets, etc.	Tons	2,078	2,631
Aluminium	Tons	898	855
Mercury	Lb.	189,755	89,622
Zinc Oxide	Tons	947	731
White Lead	Cwt.	12,163	20,479
Red and Orange Lead	Cwt.	4,415	3,680
Barytes, ground	Cwt.	39,088	57,785
Asbestos	Tons	1,885	1,433
Boron Minerals	Tons	594	803
Borax	Cwt.	9,800	25,285
Basic Slag	Tons	2,843	7,065
Superphosphates	Tons	2,123	4,112
Phosphate of Lime	Tons	26,658	34,672
Mica	Tons	214	165
Sulphur	Tons	220	6,488
Nitrate of Soda	Cwt.	46,207	68,873
Potash Salts	Cwt.	385,312	520,442
Petroleum: Crude	Gallons	42,392,357	44,398,599
Lamp Oil	Gallons	26,615,101	17,667,272
Motor Spirit	Gallons	69,103,989	79,061,204
Lubricating Oil	Gallons	8,147,700	7,617,943
Gas Oil	Gallons	12,797,796	7,765,741
Fuel Oil	Gallons	47,944,158	44,453,279
Asphalt and Bitumen	Tons	18,355	17,169
Paraffin Wax	Cwt.	127,921	141,730
Turpentine	Cwt.	98,859	28,635

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES.

In Tons.

	September.	October.	November.
Anglo-Ecuadorian	15,752	16,362	16,323
Apex Trinidad	40,430	41,820	36,850
Attock	1,936	1,805	1,815
British Burmah	4,589	4,667	—
British Controlled	30,588	35,814	33,990
Kern Mex	784	861	822
Kern River (Cal.)	2,696	2,732	1,751
Kern Romana	2,467	2,241	2,290
Kern Trinidad	4,152	3,836	4,389
Lobitos	28,501	29,257	28,164
Phœnix	51,890	37,527	50,985
St. Helen's Petroleum	5,696	6,251	6,137
Steaua Romana	60,100	50,550	51,310
Tampico	3,041	3,137	2,998
Trinidad Leaseholds	28,500	26,350	23,300
Venezuelan Consolidated	—	—	—

QUOTATIONS OF OIL COMPANIES' SHARES.

Denomination of Shares £1 unless otherwise noted.

	Nov. 10, 1930.			Dec. 10, 1930.		
	£	s.	d.	£	s.	d.
Anglo-Ecuadorian		11	6		10	9
Anglo-Egyptian B.	1	17	6	1	16	9
Anglo-Persian 1st Pref.	1	8	9	1	8	6
,, ,, Ord.	2	18	9	2	17	6
Apex Trinidad (5s.)		12	6		11	9
Attock	1	0	0	1	1	3
British Burmah (8s.)		4	3		4	9
British Controlled ($5)		1	3		1	6
Burmah Oil	3	16	3	3	10	0
Kern River Cal. (10s.)		3	3		2	9
Lobitos, Peru	1	5	0	1	8	0
Mexican Eagle, Ord. (4 pesos)		7	9		7	0
,, ,, 8% Pref. (4 pesos)		7	9		8	0
Phœnix, Roumanian		7	6		7	6
Royal Dutch (100 fl.)	26	0	0	25	15	0
Shell Transport, Ord.	3	16	3	3	16	9
,, ,, 5% Pref. (£10)	10	1	3	10	1	3
Steaua Romana		5	9		6	3
Trinidad Leaseholds	1	1	3	1	7	6
United British of Trinidad (6s. 8d.)		5	0		4	3
V.O.C. Holding	1	11	3	1	11	9

PRICES OF CHEMICALS. Dec. 9.

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

		£	s.	d.
Acetic Acid, 40%	per cwt.		18	9
,, 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.			11
,, 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	5	0
Antimony, Tartar Emetic	per lb.			11
,, Sulphide, Golden	,,			7
Arsenic, White	per ton	19	0	0
Barium, Carbonate, 94%	,,	4	10	0
,, Chloride	,,	9	5	0
,, Sulphate, 94%	,,	6	15	0
Benzol, standard motor	per gal.		1	5½
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	3
Copper Sulphate	per ton	21	0	0
Cresylic Acid, 98–100%	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	0	0
,, Nitrate (ton lots)	,,	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. S.G. 1·500	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	10	0
,, Ethyl Xanthate	per 1,016 kilos	55	15	0
,, Hydrate (Caustic) 88/90%	per ton	28	10	0
,, Nitrate	,,	19	17	6
,, Permanganate	per lb.			5½
,, Prussiate, Yellow	,,			6½
,, ,, Red	,,		1	8
,, Sulphate, 90%	per ton	11	0	0
Sodium Acetate	,,	18	0	0
,, Arsenate, 45%	,,	20	10	0
,, Bicarbonate	,,	10	10	0
,, Bichromate	per lb.			3¾
,, Carbonate (Soda Ash) 58%	per ton	8	0	0
,, ,, (Crystals)	,,	5	5	0
,, Chlorate	,,	23	0	0
,, Cyanide 100% NaCN basis	per lb			8
,, Ethyl Xanthate	per 1,016 kilos	53	5	0
,, Hydrate, 76%	per ton	14	10	0
,, Hyposulphite	,,	9	2	6
,, Nitrate (ordinary)	,,	9	15	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 (S.P.A. 16%)	,,	3	9	0
Tartaric Acid	per lb.		1	0½
Turpentine	per ton	38	5	0
Tin Crystals	per lb.			11¾
Titanous Chloride	,,			10
Zinc Chloride	per ton	9	10	0
Zinc Dust, 90/92%	,,	20	0	0
Zinc Oxide (White Seal)	,,	39	0	0
Zinc Sulphate	,,	9	0	0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

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

COPPER:		
Bwana M'Kubwa (5s.) Rhodesia	8 9	7 0
Esperanza Copper, Spain	1 1 6	1 1 6
Indian (2s.)	1 3	1 3
Loangwa (5s.), Rhodesia	2 6	2 0
Luiri (5s.), Rhodesia	3 3	3 6
Messina (5s.), Transvaal	8 6	9 0
Mount Lyell, Tasmania	19 0	12 6
Namaqua (£2), Cape Province	7 6	7 0
N'Changa, Rhodesia	2 0 0	1 16 3
Rhodesia-Katanga	17 6	17 6
Rio Tinto (£5), Spain	30 0 0	31 0 0
Roan Antelope (5s.), Rhodesia	17 0	13 9
Tanganyika, Congo and Rhodesia	1 5 9	1 8 0
Tharsis (£2), Spain	3 10 0	3 10 0

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

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

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

SULPHIDE FLOTATION IN SEA WATER

The use of sea water in the flotation of chalcopyrite at the concentrator of the Compañia Minera de Tocopilla, at Tocopilla in Northern Chile, is described by A. K. Burn in the *Bulletin* of the Institution of Mining and Metallurgy for November and full extracts from his paper are given here.

The author states that the mines of the company are located on the shoulder of one of the foothills running up to the coastal range of Chile between Antofagasta and Iquique. They lie at between 400 and 500 metres above sea-level, and the railway of the Anglo-Chilean Consolidated Nitrate Corporation runs through the property on the way to nitrate *oficinas* on the pampa above. The mines are working mineralized veins formed along the contact between an andesite dyke and a diorite. The dyke strikes N. 75° E., the dip being nearly vertical. It has been proved for over a kilometre in length, and the lowest workings are 490 metres deep (190 metres below adit level).

The ore contains nearly pure chalcopyrite, although occasionally a little chalcocite is encountered and there are traces of molybdenite, which is characteristic of copper mines in this part of Chile. The ore from the Despreciado mine, which is on a fissure vein, is rather higher in iron pyrites than the normal, whilst the dump, largely obtained from old workings near the surface, carries native copper, oxides, carbonates and atacamite. The mineral carries small gold values running from 1·5 gm. per ton in the export ore to 3 gm. in the concentrates.

The mines are about 4 kilometres from the mill, to which they are connected by a single-rope Bleichert aerial ropeway, with a capacity of from 30 tons to 35 tons per hour. The buckets, about 95 in number, carry an average of 325 kg. each. The ropeway divides at an angle-station into a Y, one leg of which runs to Minita, which is the exit at the western end of the vein from the main haulage tunnel, the other leg terminating at Despreciado at the other exit. The main offices, workshops, and officials' and workmen's dwellings, etc., are at the latter point.

The concentrator is located on the shore of the Pacific Ocean at the north end of the town of Tocopilla. The port end of the ropeway discharges into a two-compartment bin, each compartment with a capacity of 100 tons. One half is used for "export ore" which is a selected product carrying from 15% to 16% copper; this is exported, after sampling, without further treatment. The other compartment is for concentrating ore which goes to the mill. This consists of rejects from the export ore, ore specially mined for concentrating, and a proportion of dump material, the whole averaging about 4% Cu., partially oxidized.

From the ropeway bin the ore passes through a Krupp breaker, 500 mm. by 280 mm. opening, where it is reduced to 3 in. The 3 in. product from the Krupp breaker is sent to a 3 ft. Symons cone crusher which reduces it to ¼ in. From the Symons the ¼ in. product is taken by a 16 in. conveyor to the mill storage bin having a capacity of 200 tons, the bin discharging by means of five "wall-box" type feeders on to a conveyor which feeds the first 4 ft. by 10 ft. rod-mill.

The product from the first rod-mill, which is in open circuit, is elevated to a "drag" classifier the overflow of which is designed to give a minus 40 product. The oversize, or coarse product, passes to a second 4 ft. by 10 ft. rod-mill which is working in closed circuit with another drag classifier also designed to give a minus 40 product. A proportion of the oversize from this classifier can be returned to the first rod-mill if conditions call for this. The fine-crushing installation of two 4 ft. by 10 ft. rod-mills has a capacity from 250 tons to 300 tons a day from ¼ in. to minus 40. The overflows from the two classifiers join at a box feeding a 3 in. Wilfley sand pump which delivers the prepared feed to the flotation cells, the dilution being 3·8 to 1.

The flotation section has replaced a previous arrangement by which the ore was treated by jigs and tables, the idea being to send a middling product only over the tables to flotation. This proved unsuccessful, as the grade of concentrates and the recovery were poor, and the complication of so much machinery proved unnecessary. In a sea-water circuit the less machinery to be subjected to the corrosive action of the water the better. Two of the tables have been retained to act as "pilot" tables and to recover a small product of chalcopyrite too coarse to be floated. This product is returned to the crushing circuit. These "pilot" tables enable the cell operators to observe the working of the flotation and correct any falling-off due to want of reagents, etc.

The flotation section now consists of four "air agitation" cells, two "rougher" cells each 12 ft. long and two re-treatment cells 8 ft. long. The "rougher" cells discharge concentrates on both sides, whilst the concentrates re-treatment cells discharge on one side only. The tailing from the second "rougher" cell passes over the "pilot" tables before mentioned.

The concentrates are re-treated twice, the feed to the first being about 19% Cu and the concentrates 24%. The second cell is divided into four compartments, final concentrates of 27·5% Cu being taken off the first three divisions while the fourth division returns to the middlings. The final concentrates launder is so arranged that two divisions can be cut into the middlings, which return to the crushing circuit. The divisions give the following products:—

	% Cu.
1st	30·0
2nd	25·8
3rd	22·8
4th	18·0

The treatment cells are provided with rotary

"lifters" to remove the concentrates, thus preventing an overflow of solution carrying fine gangue slimes. The solution is kept at least four inches below the overflow. The middlings assay about 5% Cu. Air is obtained from a No. 3 Roots blower giving 1,600 cu. ft. of air at 3 lb. pressure, the power used being 18 to 19 h.p. The upkeep on the cells is practically negligible, the only wear being due to sand scouring the end of the airpipes.

All kinds of reagents have been tried, and for a long time the best all-round results were obtained from a "collector" consisting of 50% Lobitos Diesel oil, 50% Minerals Separation flotation oil, or an oil from the Santiago Gas Works (A.F.G.), "reconstructed" with 6% sulphur. This is added at the first rod-mill. The "frother" was usually G.N.S. No. 5. These have recently been replaced by a German product known as "Flotol" which has some marked advantages and is now used alone with xanthate. It is added chiefly to the primary rod-mill, with a small amount entering the pump feeding the cells to meet variations in the feed. A small amount of xanthate seems to aid in the recovery of the carbonates. The circuit is slightly alkaline (p.H. 8) no chemical being added to the circuit of sea water.

Some of the most modern reagents, such as cresylic acid with P_2S_5, fail to raise as coarse a concentrate as the mixture in use, while others, although perhaps equally efficient, cannot compete in cost. Cresylic compounds appear to lose their frothing powers in sea water. Sea water itself has the property of carrying air in suspension for a considerable time. Clean sea water in a MacDonald or Callow cell will form an intense froth many inches deep and this is apt to deceive an operator not accustomed to this "natural" froth, as it has little or no mineral-raising power although the cell may appear to be in good working condition.

The concentrates are settled with remarkable ease. Two small circular tanks of a capacity for about 20 tons of concentrates working in series are sufficient to give an almost clean overflow of solution without the addition of any lime or other chemical to aid settlement.

The sea water apparently permits the flotation of a distinctly coarse concentrate, and due to the coarseness of the concentrate it is possible to do away with the use of filters, the concentrates being dried on cement floors by the sun and wind, where they are ready to be placed in the storage piles after two or three days' exposure. The salt very effectually acts as a binder, preventing dust losses. So far as the flotation of the chalcopyrite is concerned there appears to be no difficulty in the use of sea water; in fact it seems to have advantages, such as the coarseness of the concentrate and the ease of settlement.

The amount of reagents used can be reduced by the addition of lime but in this particular case lime is expensive and not easily procurable, while the concentrates are much more difficult to control. The mill receives a varying feed, depending on the portion of the mine from which it comes and still more due to dump material which is considerably oxidized, and it is found that the reagents in use meet the varying conditions with but little attention on the part of the operators.

Occasionally a sulphide-surface "adsorbing" gangue which requires the use of sodium silicate or crude petroleum to cause dispersion occurs, but apart from this, a slight change in the amount of frother serves to smooth out the variations. One advantage in the use of lime in sea water is the protection it gives to the metallic surfaces of the machinery against corrosion, which is quite a factor in the plant, and is probably aggravated by the presence of organic matter from sewage. High-grade copper tubing in coolers, etc., lasts only about two years; Admiralty brass is better; the presence of manganese in cast-iron is markedly deleterious, the purer the iron the higher the resistance—so much so, that a very pure iron gives as good resistance as brass or copper. Six-inch black-iron pipes, carrying water from the main pumps, are in good order after five years. Galvanized sheet iron is very susceptible to the action of the damp from the sea and it is better to use black-iron sheets, well painted with iron oxide or anti-corrosive paint. Most of the buildings are of stucco on expanded metal; this works very well, as frequent slight earthquakes occur which may crack the stucco, but it is too light and elastic to take permanent harm, whilst in addition it is fire-resisting. Oregon pine is the wood generally used; native woods of the same class are quickly destroyed by *polilla*, a kind of termite, which does not attack the pine until the natural resins disappear; this takes some years.

Power is obtained from a 700 h.p. M.A.N. Diesel engine of the solid-injection 4-cycle type, direct-coupled to an alternating generator, 3-phase, 50-cycle, 380 volts; the current is transformed to 10,000 volts for transmission to the mines. This set serves for both the mine and the mill. There is also a stand-by Diesel engine of 360 h.p. made by Otto Deutz, which is used in case of a shut-down of the main 700 h.p. set, in which case the mine uses a group of small Fairbanks semi-Diesels. This arrangement is very seldom called upon, as the M.A.N. gives good service, and as the mill does not work on Sundays this gives the necessary time to change the valves and for the overhaul so important to the good running of a Diesel engine. Power for 1929 cost 9·43 cents Chilean per h.p. hour (0·566d.), including amortization and overhead. The fuel used is a Diesel oil from Lobitos, Peru, with a B.T.U. of 19,250. It has a paraffin base.

This form of power is ideal for small power units but it must be borne in mind that a Diesel engine engine cannot run for weeks at a time without stopping as can a steam engine or turbine, and that allowance must be made for stopping at regular intervals to clean valves, etc. The waste heat from the exhaust should be utilized to obtain the full value of a Diesel engine and in this case it is used to distil sea water, as potable water costs 4s. a cubic metre in Tocopilla.

The labour laws of Chile are very advanced and favourable to the workmen. There is compulsory saving and sick and death insurance, employers paying 4% and the workmen 3% on the weekly earnings. A company showing profits has to divide a proportion among their *empleados* up to 3 months' wages, with a maximum of $1,500 a month (£37 10s.). The definition of an *empleado* is one whose work is more mental than physical and this has led to many disputes, but there are Arbitration Courts appointed by the Government who administrate the business in a commonsense manner. A workman must receive six days' notice of dismissal or a *deshaucio* of six days' pay.

It is customary to pay the six days, as a man under notice naturally loses interest in his job. Under certain conditions, such as coming to work in an alcoholic condition, a man may be dismissed summarily. Speaking generally these laws work well and do away with casual labour.

The climate of this part of Chile is almost ideal; in fact Tocopilla has been described as 90% climate, 9% nitrate and 1% copper. The days in the summer time are hot, but the nights, due to the cold "Humboldt current," are always cool enough to enable one to sleep. While the winter is mild there is enough difference to have a toning effect. At present all potable water is distilled, but it is expected that water will be available from the Cordillera above Chuquicamata within two years. The piping is already delivered and the laying of it has been started. The work will cost £400,000, and will mean a great alleviation to the life in Tocopilla, as it will permit of gardens, etc., and is expected to reduce the cost of water from 4s. to 10d. per cubic metre.

REPAIR OF A COLLAPSED SHAFT ON THE RAND

Sinking of the Deep North Shaft (7 compartment, 42 ft. by 8 ft.) on the Randfontein Estates, now known as No. 2 North Shaft, was started in April, 1910, and stopped during 1912 owing to the intersection of watercourses giving approximately 1,000,000 gals. per day, the total depth sunk being 2,083 ft. During the rainy season of 1925 the upper portion of the north side of the shaft caved, forming a cavity starting from the north ends of the shaft and extending in a semi-circle to a distance of 47 ft. north from the centre of the long axis, the crater being about 50 ft. deep. Some notes on the collapse and on the recovery of the shaft are given by H. J. Hebbard and W. H. Mitchell in the *Journal* of the South African Institute of Engineers for November.

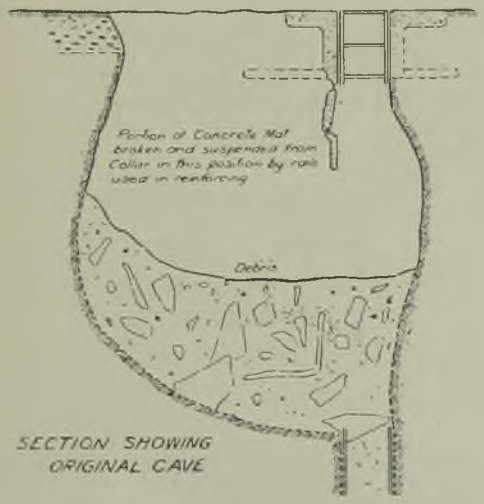


FIG. 1.

The authors state that the shaft was sunk in a formation dipping at about 34° east, with a strike north and south, the long axis of the shaft being east and west. After the collapse the concrete collar was left suspended from the south side concrete mat, but the cave carried away the shaft timbers for about 200 ft. and jammed above the bearers at 300 ft. down. It is believed that the cause of the collapse was the weathering of a strike dyke, dipping 25° east, which came through the east end of the shaft at about 60 ft. down. On exposure this dyke decomposed and caused it to swell, and as the timbers rotted they were unable to withstand the increased pressure and ultimately collapsed, allowing the dyke to run. In this manner a trough was formed in the sandstone up to the overlying Black Reef formation; the latter was in turn unable to support the undermined surface, and a crater was thus formed. (Fig. 1.)

Some twelve months before it was decided to re-open the shaft, a rough calculation showed that the choke had taken place somewhere about 250 ft. down. In order to confirm this, a 45° winze was sunk in a westerly direction from a point 300 ft. due east of the east end of the shaft. When this winze had reached a vertical depth of 250 ft.

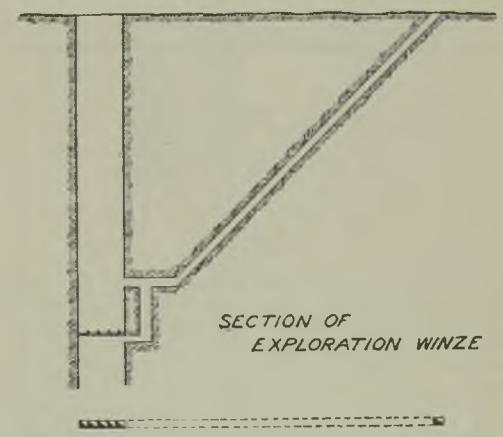


FIG. 2.

a cross-cut was driven from the bottom of the winze to intersect the eastern end of the shaft. The holing was found to be in a choked portion of the shaft, and it was decided to sink vertically a further 50 ft., leaving a 15 ft. pillar between shaft and winze. After sinking the 50 ft., another cross-cut was driven into the end of the shaft, and the choke was found to be some 20 ft. above this point. A complete set of bearers and a penthouse were built, and the gap between penthouse and bottom of cave was filled with old timber; this was done to prevent the choke shifting. (Fig. 2.) The shaft timbers below the choke

were found to be in good condition. Before any actual work had been done on the collar sett, a re-survey showed that the concrete collar itself had not been distorted.

The surface layout of the shaft calls for a headgear bin of 600 tons actual capacity, under which an ore train will pass centrally along a line parallel to the major axis of the shaft and directly over the filled-in crater. This filled-in crater will ultimately be required to support the headgear and the bins containing 600 tons of rock, a 45-ton locomotive and eight hoppers of 65 tons gross weight. The above weight, approximately, 1,500 tons, in addition to such stresses as might arise owing to ground movement, will be transmitted to the north wall of the shaft, which may, therefore, be considered as a beam with a 45 ft. span. It was decided to reconstruct the shaft by replacing

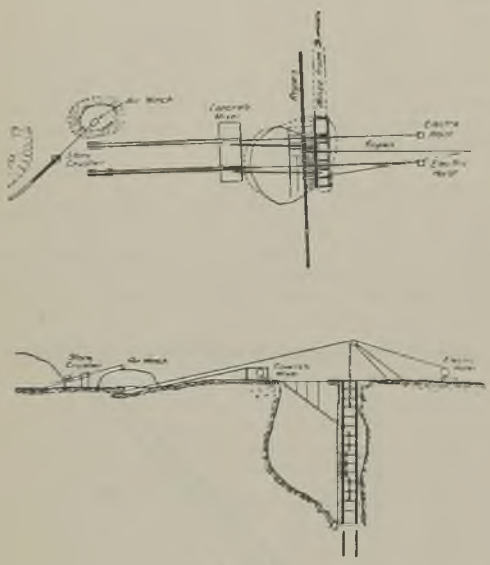


Fig. 3.

the damaged setts with new timber, to build up a concrete collar from a point where the strata were sufficiently strong to permit of this, keying it into the original concrete collar, and subsequently to fill the remainder of the cavity with a low-grade concrete. In view of the large weight to be carried on this cavity, two concrete dividers are included in the design to assist the support of the north wall.

Preparation.—A concrete plant of the following design and capacity was erected :—Two ¾ cu. yd. mixers were placed on the north side of the shaft and as near to the crater as safety permitted. The mixers were placed in such a position that each supplied concrete to half of the shaft. A 24 in. by 10 in. crusher and trommel to give 2 in., ¾ in., and ½ in., gradings were erected at the foot of the existing dump, and in such a manner that by sinking pits at each side of trommel, trucks could be hoisted by means of temporary winches direct to the mixer platforms. (Fig. 3.) The pits also enabled the correct quantities of rock, sand and cement to be loaded from the trommel platform, so that the aggregate was hoisted direct to the mixer and tipped with a minimum of labour.

It was quite evident that whatever method was used it was essential to guard against any disturbance of the old collar sett, so two 1¼ in. wire ropes were stretched across the short axis of the shaft and attached to the girder projections under No. 1 and No. 4 dividers of the collar sett, these ropes being anchored to the concrete foundations of the old hoist. Also, two 1¼ in. ropes were placed under the cross girder projections, the ropes running parallel to the long axis of the shaft, and anchored to 12 in. pipes, which were set in concrete. (Fig. 3.) A block and tackle was used to strain these ropes ; the ropes being further tightened by jacking from the ground and packing them up with timber.

The next step was to release the north side concrete mat which the cave had burst and left hanging on the concrete collar ; this mat, weighing some 50 tons, was hanging by the old reinforcing rails. Two 60 ft. girders were placed across the top of the crater about 20 ft. apart, and from these girders a platform was hung, which allowed the

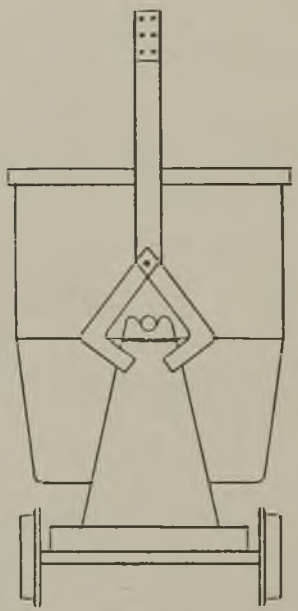


Fig. 4.

boilermaker to burn through the reinforcing rails, etc., dropping the mat, which had broken into three pieces, on to the top of the cave ; the two outside pieces were dropped first, the centre portion last. The old shaft timber setts, which were in a very rotten condition, were treated in a similar manner by burning the hanging bolts. During this period two 120 h.p. electric winches were erected on the south side of the shaft, about 50 ft. from the collar, to serve No. 3 and No. 6 compartments, each winch operating a 30 cu. ft. bucket. To avoid any unnecessary load or vibration on the collar of the shaft, each winch was equipped with a 50 ft. jib to carry the ropes into the compartments. For cleaning out, buckets with trunnions were used (Fig. 4), a jump-set being

dropped across the compartment, the bucket being then lowered into a carriage, which was trammed and tipped, four buckets and four carriages being used.

TIMBERING.—As soon as the old collar sett had been freed from the old mat, re-timbering was taken in hand, the setts were swung from the collar sett without attempting alignment, as no shaft wall existed to permit of blocking. After nine setts had been put in (6 ft. centres), the top of the cave was reached on the western end of the shaft; cleaning out was then started through No. 3 compartment, the eastern end having another 20 ft. to go to reach the cave.

After sinking about 20 ft., the north-western side of the shaft came into the solid, and the opportunity was taken of installing four timber bearers. These bearers were placed under the west end plate, No. 1 and No. 2 dividers, and the east end plate respectively, the rest of the northern side being in loose ground. Although the east end of the shaft was in fairly good ground, the precaution was taken of cutting a step to take a small concrete mat to support the fourth bearer. The installation of these bearers now allowed the weight of the shaft timbers to be taken off the collar sett. The south wall of the shaft was in fairly good ground, after having passed through the Black Reef formation at about 30 ft. from the surface.

At a point 70 ft. down from surface it became apparent that spiling would have to be resorted

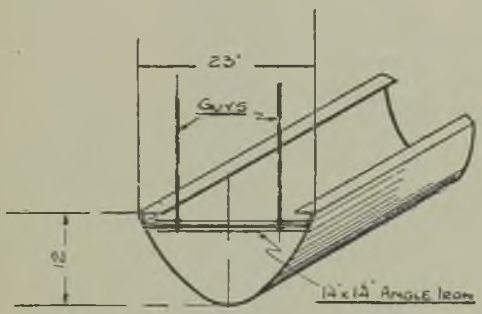


FIG. 5.

to for 25 ft. of the eastern portion of the north side of the shaft which was in soft soil. In order to start the spiling, and also to allow sufficient space for the north side concrete wall, it was decided to carry false setts 3 ft. 8 in. (inside timbers) from the north wallplate over this 25 ft. of difficult ground, starting from the east end of the shaft. After the second false sett had been placed in position, spiling was started and the shaft cleaned out for a further 20 ft., making 90 ft. in all. The shaft was now in solid rock on all four sides. Hitches were then cut for steel bearers to be put under end plates and dividers, the steel bearers were blocked 12 in. above the bottom of the hitches, so that when the concrete walls were started, concrete could be packed under and around them, making the bearers integral with the concrete walls. After the bearers were blocked in position, the surface soil, etc., behind the spiling was bled from the bottom, run into the shaft and hoisted to the surface.

The whole of the bottom of the crater was now in fairly solid rock, and was then stepped to give a better base for the concrete mat and walls. The steps were cut to step down from west to east and running north and south for a distance of 25 ft. from the west side of the crater; over the remaining 17 ft. of the north side of the shaft, the steps were stepped down from north to south and running east to west.

The wallplates were spliced and plated; the splices were staggered so that no two splices were under each other, and the wallplates were dropped in two pieces for easy handling, the splice bolted and plated after the wallplate was in position.

The joint between end plates and wallplates was not the orthodox one; in this case the dove-tail joint was used and 6 in. horns were left on the ends of the wall-plates; the end plate being secured in position by a bolt through these horns.

To prevent the dividers falling out of the dove-tail, owing to the wallplates swinging, a palm bolt was used to secure each divider to the wallplate.

CONCRETING.—Before any concrete was run in, plumb lines were dropped in the shaft. These

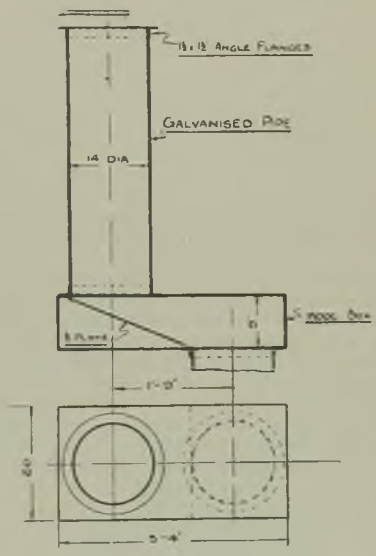


FIG. 6.

lines showed that ¾ in. was the maximum error, and, as 7 in. were allowed between the wallplates and face of the concrete walls, there was no object at this stage in aligning the setts until the concrete walls were built and set.

The concrete from the mixers discharged into two trough launders, constructed of 6 ft. by 3 ft. galvanized iron, 16 gauge (Fig. 5), suspended from ropes running from the north side of the crater to the collar of the shaft, the inclination of the launders being approximately 35° to the horizontal. The concrete was thus gravitated to convenient points inside the shaft timbers about 70 ft. about the new main bearers, and thence shot down through ordinary 22 gauge, 14 in. diameter piping.

The 14 in. vertical piping was in 12 ft. lengths, and was staggered and provided with header boxes to break the velocity (Fig. 6), the delivery of the

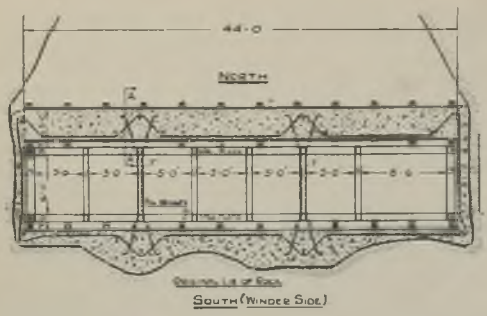


FIG. 7.

bottom vertical piping again discharging into incline suspended launders, hung in such a manner that the concrete could be run into any portion of the shuttering as desired.

The concrete dividers incorporated in the design were spaced to break up the 45 ft. beam into three beams, giving the following spans from west to east :—16 ft. 9 in., 11 ft. 7½ in., 20 ft. 8½ in. These dividers were built as an integral part of the retaining wall or concrete collar as shown (Figs. 7, 8 and 9), but were not continuous for the total depth of the latter, as room had to be left for the replacement of timber and the manipulation of the brackets and bolts, thus necessitating a gap of 9 in. above and 3 in. below each timber divider. After timbering and during spiling operations, the stringers for the shuttering of main walls were put in place so as to give 7 in. clearance between walls and shaft timbers, and to allow for future alignment, blocking and repairs.

The shuttering and binding were of 1½ in. and 4 in. by 3 in. timbers respectively, and to facilitate the recovery of the shuttering easily, removable wedges were inserted between the stringers and wallplates. The boxes for the dividers were constructed to plan at the shops and made ready for quick assembling on the job. The reinforcement consisted of ⅜ in. reinforcing steel, and these were all bent to template, as shown in sketch (Fig. 7) before commencement of the job; the quantity of reinforcement is on the heavy side, as an extra safeguard in the event of an accident in the shaft at a future date.

The method of erecting the divider boxes on the job was as follows :—The one side of the box was erected in place, the reinforcement rods were lashed in the correct position with bonding wire to the upright rods, and then the other side of the box was completed. The main walls were reinforced with rods in the usual manner for beams, and thoroughly annealed stranded wire rope was also used.

Wire rope was used to reinforce the weaker mixture in the crater, the ropes were laid along the main wall proper and run out through the outer shuttering into the crater portion. The shuttering and running of concrete were carried out in the following manner :—The first four divider boxes with their reinforcement rods were put into position and the first three feet of main wall shuttering. No outer shuttering was used until 20 ft. of wall had been built, the concrete being allowed to run to the angle of repose in the crater, thus forming a strong and substantial toe for the wall. (Fig. 10.)

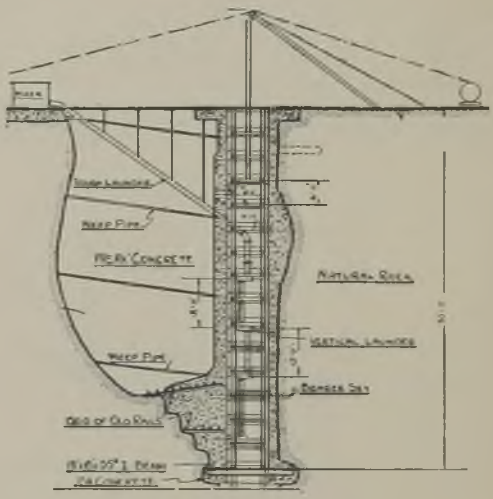
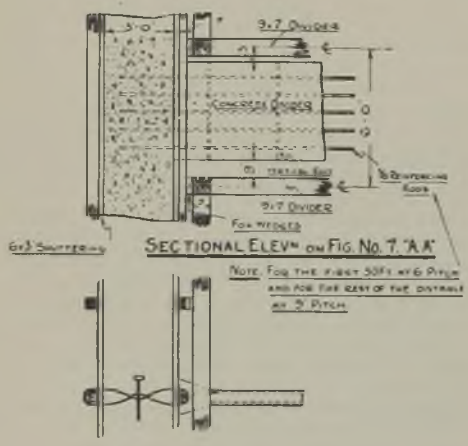


FIG. 10.



FIGS. 8 AND 9.

This toe was further strengthened by two rail grids across the shaft, one 6 ft. from the bottom, the other 16 ft. from the bottom, also necessary weep pipes were put into position before the commencement of concreting. The erection of the divider boxes was continued at the same rate as the main shuttering, the shuttering was then laid in at the same rate as the concrete, so that good tamping and supervision were possible; but in respect to the main wall and dividers, no waiting for any portion was permitted during the whole of the concreting period.

In consideration of the ultimate load, vibration, etc., the crater was filled in with 18 to 1 concrete, and ropes, led through the shuttering for that purpose, were run out and laid in the crater concrete at the desired places. The completed work entailed the use of approximately 1,200 cu. yd. of 9 to 1 concrete for the main retaining walls and 6,000 cu. yd. of 18 to 1 concrete for the crater, or about 14,000 tons in all.

THE VALUATION OF A PROSPECT

In the *Canadian Mining and Metallurgical Bulletin* for November, D. C. McKechnie deals with a problem which frequently confronts the mining engineer. The author is aware that most of the problems discussed in his paper are obvious to the engineer, but a number of them are worthy of presentation. While the purpose of his paper is to deal with prospects or potential mines, many of the problems considered apply equally well to mines with developed ore reserves. As the usual showings on a prospect consist chiefly of a few open-cuts and a limited amount of underground development work, an estimation of the actual ore reserves is a question of minor import, and seldom enters appreciably into an estimation of the probable value of the particular property. The physical valuation of a prospect mainly involves the consideration of such subjects as the general geological features exposed, the strength and type of mineralization, the width and persistence of any associated veins, shear-zones, fractures or contact-zones, together with the possible grade, size, and continuity of any ore-bodies that may there occur.

It is obvious that no exact valuation of the above factors can be made. The property, if otherwise satisfactory, might be acquired on an option basis. There are, however, certain factors, which, though usually out of the control of the operator, may be fairly well estimated prior to the actual mining operations. A careful consideration of these factors will often do much towards leading to the correct appraisement of the property. A complete enumeration and consideration of these factors is not within the scope of the author's paper, though a few are mentioned.

(1) *Transport Facilities.*—In the first place, this factor includes the consideration of the hauling and handling charges. Secondly, an estimation of the possible size of the ore-body or the proximity of a large property. In both of these cases, certain facilities may be so increased as greatly to lower the cost of transport.

(2) *Type of Ore.*

(3) *Grade of the Concentrate.*—This data may only be obtained from mill tests.

(4) *Mill Recoveries, Smelter Rates,* and *Losses.*

(5) *Prices* and *Markets* for the metal produced.

(6) *The Net Cash Value of the Concentrates* produced per ton of ore, after allowing for mill losses, freight and handling costs of the concentrates, and the smelter charges and losses.

The last item is, in fact, a combination of all the preceding ones, and on it directly depend the profits to be expected from the ore.

The author, who is, of course, writing of Canadian conditions, points out that it is sometimes customary to state the value of an ore in dollars and cents, with the calculations based on the assay value of the ore and New York prices for the base metals. In the cases of gold and silver ores, this is justifiable, as, by allowing for the probable metallurgical losses, the net value of the ore can be calculated. In the cases of the base metals, and particularly in those of lead and zinc, the use of such methods may lead to results that are misleading and usually far from correct. An effort is made to show the wide discrepancy between the assay value of an ore and the returns that ore will earn after freight costs, treatment charges, and losses are deducted.

The causes of this discrepancy are numerous, the most important of which are enumerated below :

(1) In Canada the lead and zinc quotations are based on the London markets and converted into Canadian funds. This price is often considerably lower than the New York quotations.

(2) Certain deductions are always made by smelters to cover the marketing and freight on the metals. This deduction varies from one and one-quarter cents per lb. in the case of lead up to three cents per lb. in the case of copper.

(3) Metallurgical losses, smelter treatment charges, and freight rates all help to lower the net returns to be expected from the ore.

The table on p. 372 will furnish a comparison between the different types of ore, with allowances made for certain grades of concentrates and different freight rates. In the compilation of the table, certain assumptions have been made and these are dealt with below :

(1) The metal prices used are : gold at $20 per oz. ; silver 50 cents an oz. ; copper 16 cents lb. ; and lead and zinc each at £23 sterling per long ton. In the last two instances, the price, when converted into Canadian funds, at the normal rate of exchange, is practically equivalent to 5 cents per lb.

(2) With the exception of the last example, the table has been prepared by assuming an original assay value of $10 per ton. For example, a 10% lead ore with the price of lead at 5 cents per lb. is theoretically worth $10 per ton.

(3) A mill recovery of 90% has been assumed in all cases.

(4) Smelting rates have been regarded as those in current use in British Columbia. As there are no smelters quoting a schedule for copper ores, it has been assumed that a treatment charge of $5 per ton is made, while the amount of copper paid for is obtained by deducting 20 lb. from the amount of copper contained in the concentrate and paying for the balance at the current price, less 3 cents per lb.

The first example in the table is included merely for the sake of comparison, while the second is assumed to be a concentrating ore in which the values are in the precious metals, and with a concentration ratio of 40 to 1. Two examples are given in the case of each of the base metals in order to show the relation of the grade of the concentrate to the net value of the ore. This figure may be considerably influenced by a lower recovery being made. The last example is that of a copper ore having an assay value of 1% copper. In the first column is given the respective types of ore, while the second shows the original grades of the ores on which the calculations are based. The concentrate grades, values, and tonnages are represented in the next three columns. The grade indicated is simply that of the concentrate produced. The value of the concentrate includes an allowance for smelter charges and deductions, but no consideration of freight rates is included. The concentrate tonnage is the product of the mill recovery and the ratio between the respective grades of the original ore and the concentrate produced.

Finally, the last three columns bring into consideration certain transport costs. The first of these represents the product of the figures of the third and fifth columns, and thus it represents the

Type of Ore.	Grade of Ore.	Concentrates.			Net Value of Concentrates from one ton, allowing for certain haulage charges.		
		Grade.	*Value.*	*Amount.*	*None.*	$5·00.	$10·00.
	oz. or %	%	$	tons			
Free milling ores, gold and silver	Au 0·50 oz.	No concentrate			9·00	9·00	9·00
Concentrating ores of gold and silver	Au 0·50 oz.	——	390·00	0·0225	8·78	8·65	8·56
Copper ores (Ex. 1)	3·125%	20%	44·40	0·141	6·26	5·55	4·85
Copper ores (Ex. 2)	3·125%	10%	18·48	0·281	5·17	3·76	2·36
Lead ores (Ex. 1)	10·0%	60%	30·50	0·150	4·58	3·82	3·08
Lead ores (Ex. 2)	10·0%	45%	20·30	0·200	4·06	3·06	2·06
Zinc ores (Ex. 1)	10·0%	60%	20·75	0·150	3·11	2·36	1·61
Zinc ores (Ex. 2)	10·0%	45%	13·15	0·200	2·63	1·63	0·63
Copper ores (Special)	1·0%	20%	44·40	0·045	2·00	1·77	1·55

net cash value of the concentrate produced from one ton of ore, with the assumption that there are no transport costs from the mill to the smelter. The second last column under transport costs indicates the results of an allowance made for a charge of $5 per ton for the transport from the mill to the smelter. These figures are the products of the corresponding values given in columns three and five, less the $5 freight charge. Similarly, the last column represents allowances having been made for transport costs of $10 per ton.

This table thus demonstrates the wide variation in the net returns from the different ores. In considering the type of ore alone, one notices an extreme variation in value, ranging from $9 per ton in the case of a free milling ore, down to $2·63 for a zinc ore producing a low-grade concentrate. When a $10 freight rate on the concentrate is deducted from this ore, the value is reduced to 63 cents for every ton of ore originally assaying 10% zinc. Further, the depressing effect of high transport costs upon the values of ores which produce a low value concentrate, such as a 45% zinc concentrate, can readily be seen. In this specific case, for instance, this zinc ore would be valueless if the transport costs equalled or exceeded $13·15 per ton. It can further be seen that the table may also be used approximately to determine the net value of ores under conditions other than those shown there.

The net value of the ore is also dependent on certain factors of importance. It depends directly on the original grade of the ore. Thus, a 15% lead ore producing a 60% concentrate, and allowing for a $5 freight rate, will be worth fifteen-tenths of $3·82, or $5·82. Mill recovery also directly affects the net value of an ore. Furthermore, this net value will also vary directly as the mill recovery made. When a 75% recovery is obtained, the net value to be received is seventy-five ninetieths of the values shown in the table. A change in the price of the metals will directly affect the net returns, the change occurring thus being approximately proportionate to the product of the price change and recoverable metallic content of the ore. This, however, does not hold true in the case of zinc when the prices rise above £24 10s. sterling.

In considering the gold and silver values contained in copper and lead ores, it is necessary to take the combined mill and smelter recovery and to it add the net value of the ore. For example, consider a copper ore carrying 50 cents in gold and silver, and assume, further, that the mill recovery is 95%, while the smelter pays for 95%, which thus means that the combined recovery is 89·2%. This percentage of 50 cents is approximately 45 cents, which amount is then added directly to the net value of the ore. Again, however, in the case of zinc ores, this does not hold directly, as here a charge is made for the treatment of the residue which contains the precious metals. This charge varies from $3·05 for a 50% concentrate up to $5·65 for a 30% concentrate of zinc ore, 80% of the gold and silver value being credited to the net value of the ore. This amount must, of course, exceed the residue smelting charges before it can be of any value in this respect.

A number of examples are to be given in order to illustrate the application of the foregoing set of figures. An ore is assumed to carry 15% lead and 12% zinc, with no values in the precious metals. The cost of transport from the mill to the smelter is here regarded as $5 per ton. The grade of the lead and zinc concentrates is assumed to be 60%, and the mill recovery 90%. The lead content of the ore is then worth fifteen-tenths of $3·82, or $5·73. The zinc value, on the other hand, will be twelve-tenths of $2·36, or $2·83. This gives the ore a total net value of $8·56 when no allowance is made for the costs of mining and milling or for the overhead charges. If this ore should carry, in addition to the base metals, silver to the extent of 10 oz. per ton, the resulting value of the ore can be determined as follows: It is assumed that the silver follows the lead, that a 90% mill recovery is made, and that the smelter pays for 95% of the silver obtained. According to these assumptions, a combined recovery of 86%, or 8·6 oz., of silver is made, which, at 50 cents per oz., has a value of

Type of Ore.	Grade of Ore.	Concentrates.			Net Value of Concentrates from one ton, allowing for certain haulage charges.		
		Grade.	*Value.*	*Amount*	*None.*	$5·00	$10·00
	oz. or %	%	$	*tons.*			
Copper ores (Ex. 1) . .	3·125%	20%	33·00	0·141	4·65	3·94	3·24
Copper ores (Ex. 2) . .	3·125%	10%	13·00	0·281	3·65	2·24	0·84
Lead ores (Ex. 1) . .	10·0%	60%	19·76	0·150	2·96	2·21	1·46
Lead ores (Ex. 2) . .	10·0%	45%	12·13	0·200	2·42	1·42	0·40
Zinc ores (Ex. 1) . .	10·0%	60%	10·65	0·150	1·60	0·85	0·05
Zinc ores (Ex. 2) . .	10·0%	45%	6·15	0·200	1·23	0·23	——

$4·30. This, being added to the base metal value of the ore, gives a total value of $12·86.

The influence of high transport costs upon the value of an ore is demonstrated by assuming that the mill is situated about forty miles from a railway. In this instance, the cost of trucking the concentrates to the railway would probably be about $10 per ton. This, added to the assumed freight rate of $10, would bring the total transport cost up to $20 per ton. Thus would a ton of lead concentrates be worth $30·50 less $20, that is, only $10·50. Since there are 225 one-thousandths tons of concentrate produced from one ton of ore, the net value of the lead is 225 one-thousandths of $10·50, which is approximately $2·36, to which amount would be added the value of the silver, thus making the total value of $6·66. Since a ton of 60% zinc concentrate is worth $20·75, it is thus rendered practically valueless when the transport costs are, as above, $20 per ton.

There are, of course, numerous factors, other than those mentioned, which affect the net value of an ore. A property may prove large enough to support its own smelter, in which case smelter charges and losses will be somewhat lower. In the case of large production, special freight and smelter rates may be obtained and the value of the ore enhanced thereby. The composition of an ore may either reduce or increase smelter charges. From the foregoing table and discussion, it is obvious that the actual net value that an ore will return is greatly different, therefore, from that obtained when only the original assay of the ore is considered.

It was not the writer's intention to present the foregoing table as a means of calculating the net value of an ore, but more particularly to demonstrate the wide variation in the net returns that may be expected from the different types of ore. Since the article was written, late in 1929, a drastic decline in the prices of silver and the base metals has taken place. In order to show clearly the effect of this decline on the net value of various types of ores, the above table has been prepared.

It will be noted particularly that, in cases where a low-grade concentrate is made, or where a high freight rate prevails, the net value of the ore declines to a much greater extent than the drop in value of the metals would indicate. The following data has been used: copper 13 cents per lb., lead and zinc 4 cents per lb. or £18 8s. per long ton (London); mill recovery 90%. The assumed value of the grade of ore and concentrates is the same as in the first table.

HELIUM: ITS PROPERTIES AND USES

Helium is now available in commercial quantities in the United States and there is a sufficient supply to meet not only the needs of aeronautics, but for other uses as well. A paper by W. E. Snyder and R. R. Bottoms in *Industrial and Engineering Chemistry* for November deals with some uses for helium which are indicated by its physical and chemical properties.

The authors point out that the outstanding use for helium is in the field of aeronautics and this use is based on its non-inflammability (chemical inertness) and its low specific gravity. Helium, by virtue of its own properties, has no lift, having a dead weight equal to 11 lb. for each 1,000 cu. ft. The weight of air under the same conditions is about 75 lb. per 1,000 cu. ft., therefore, the buoyant effect of helium is roughly 65 lb. per 1,000 cu. ft.

The new airship, *ZRS*-4, being constructed for the United States Navy Department by the Goodyear-Zeppelin Corporation, will have a capacity of 6,500,000 cu. ft. of helium. The gross lift or buoyancy, of this quantity of helium will be approximately 422,000 lb., or over 210 tons. The actual weight of the helium necessary to inflate this ship will be about 71,000 lb., or over 35 tons. If hydrogen were used in the same ship, the lift would be 455,000 pounds, and the weight of the hydrogen would be 33,000 lb., or 17 tons. This would mean a gain in total lift by the use of hydrogen of from 7 to 8%, but this advantage is usually short-lived because hydrogen diffuses through the fabric of airships about 50% faster than helium, decreasing the lift. Even without its slower diffusion rate helium's safety is the pre-eminent factor making it preferred over hydrogen.

The economic features involved in any comparison between hydrogen and helium for airship use have been discussed considerably and it has been quite definitely concluded that helium is more economical than hydrogen. This is largely due to the fact that helium can be repurified when dilution with air has decreased the lift or buoyancy to a point where economical operation demands it. Furthermore, insurance companies will insure helium-filled airships at a reasonable rate.

Another interesting property that indicates a use

for helium is its insolubility. The solubility of helium in water at 0° C. is approximately half that of nitrogen, while the rate of effusion and diffusion is more than three times that of nitrogen. E. Thompson first suggested that this property might make a mixture of helium and oxygen a desirable atmosphere for caissons or deep-sea diving. The United States Bureau of Mines at Pittsburgh has carried on a series of investigations to establish the feasibility of such a mixture for this work, and the Helium Company has established a fellowship at Purdue University for further study of this and relative matters.

Experiments carried on to date have shown that divers can work at a greater depth with more comfort and much shorter decompressing period when the helium-oxygen mixture is used as a breathing medium instead of air. The mixture prevents development of caisson disease, or "bends." Considerable fundamental data must be accumulated before this use can be developed on a commercial scale, however. It has been shown that oxygen alone will not support life. Even when mixed with other gases, with one exception, the artificial atmosphere created usually kills. The notable exception is a mixture of oxygen and helium. Life thrives in this mixture. This indicates an important humanitarian and economic use in the treatment of pulmonary and blood diseases and in crises where to-day oxygen is administered alone to sustain vitality.

Another combination of properties of helium may find use in the metallurgical field. They are its chemical inertness, high thermal conductivity, and its insolubility in certain metals, either solid or molten. This combination of properties indicates that helium might be used when melting metals to prevent the formation of blow-holes in castings or "pipes" in steel ingots, or displacement of dissolved gases. Bright metal parts have been successfully annealed in an atmosphere of helium without tarnishing. As yet this has been done only on a laboratory scale.

Another use of helium which is indicated by its high heat conductivity is in the field of heating and refrigeration. Helium has been suggested as a medium for circulation in domestic heating systems for house heating in the winter and for space refrigeration in the summer. It has also been suggested that the living quarters aboard aircraft, both dirigibles and airplanes, might be heated by means of the circulation of helium in a closed system, first heating the helium by means of exhaust from the engines, and then circulating the hot helium through radiators in the living quarters. Such an arrangement would eliminate the danger due to leakage of exhaust gases into the living quarters in cases where engine exhaust is used for this purpose.

The combination of chemical inertness, high heat conductivity, and low specific gravity should make helium valuable in the grinding and grading of powdered materials, especially those which are inflammable. The greatest value would be in connexion with the materials which are to be finely ground—say, 200 mesh or finer. By circulating the helium in a closed cycle the material could be picked up as a dust. The lightness of the helium would permit the heavy particles to drop out and leave the finer ones to be carried over to the separating equipment.

The property of chemical inertness, coupled with the high heat conductivity, makes helium of special interest as a circulating medium for drying many substances now dried by other means. Among the products that might be dried to advantage by helium are the following: albumin, casein, cereals, milk powders, electrical equipment and insulating materials, explosives, fruits and vegetables, gelatin and glue, meats and fish, organic extracts, rubber, soaps, starch, sugar, yeast; as well as all kinds of delicate organic and inorganic materials that would be adversely affected by high temperature or contact with an active gas such as air, steam, carbon dioxide, etc. The high heat conductivity gives to the use of

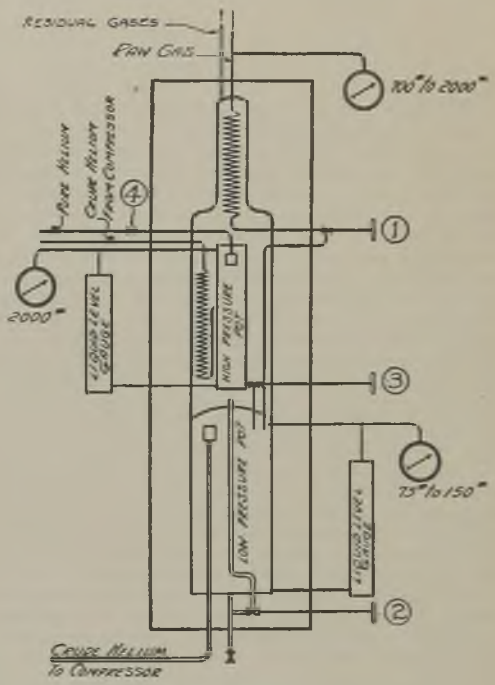


Diagram of Apparatus for the Extraction of Helium from Natural Gases.

helium as a circulating medium for drying a decided advantage over the use of a vacuum. The heat conductivity of a vacuum is so small that the material will reach a low temperature, owing to the vaporization of the moisture, and the drying operation is very slow. This drop in temperature cannot be counteracted even by circulating steam or water in the chamber. In drying with helium not only is there a much greater heat transfer, but the temperature can be kept uniform. It is a well-known physical fact that liquids in contact with fixed gases have a higher vapour pressure than when in contact only with their own vapour. As a result material can be dried more quickly when in contact with fixed gases than in a vacuum, if the gases are kept in circulation to remove the vapour.

Recent work has also indicated that helium may have a definite use in the preservation of food.

One other property of helium has been utilized in its extraction from the natural gases—that is,

its low boiling point. The simple description of the operation of one of the Helium Company's extraction plants follows. The figure gives a schematic diagram of the helium column. The raw gas containing helium, after having the carbon dioxide and moisture removed, is compressed to from 700 to 2,000 lb., and comes into the column through the entry marked "raw gas." After going through an interchanger, it is expanded through a throttle valve, 1, into a low-pressure pot, which operates at from 75 to 150 lb. From this pot a good part of the undesirable constituents are liquefied. This liquid is drawn out through valve 2 and passes out around a high-pressure pot and interchanger, out through a line marked "residual gas." The crude helium, containing from 65 to 75% helium, is taken off from the top of the pot, goes into compressors, and is recompressed to 2,000 lb., then returns through an interchanger into the side of a high-pressure pot. The impurities are liquefied and drawn off, through valve 3, into the low-pressure pot, where any dissolved helium is released at the lower pressure and recycled with the crude helium. The purified helium goes out through the line marked "pure helium" to storage or containers for shipment. The pressure on this pot is maintained by an automatic back-pressure regulator, 4.

In this process no external refrigeration is required, as all the refrigeration is obtained as a result of dropping the pressure of the raw gas. At normal atmospheric temperatures and below, all so-called permanent gases that condense to liquids at atmospheric pressure above —200° C. possess a greater amount of internal energy at low pressures than at high pressures. This difference in heat content of gases with difference in pressure is due to the latenizing of heat in the separations of the molecules of the gas against the mutual attractive forces of the molecules and to the slight separation of the atoms within the individual molecules. This is the first example known in which a gas liquefaction process has been carried out through auto-refrigeration in which the gaseous constituents all pass through a complete liquid phase. Other processes depend on external refrigeration, or throttle the constituents, all of which have not been reduced to the liquid phase.

DREDGE DETAILS

In a paper read before the Malayan Tin Dredging, Mining and Research Association on May 28 last, G. M. Beaton, of Malayan Tin Dredging, Ltd., gave some notes on dredge details. The present paper might be read in conjunction with the paper on "Bucket Dredge Practice in Malaya," by E. J. Vallentine, which was summarized in these columns in the February issue. Mr. Beaton says that rules for design and details of parts for tin dredges must in many cases be based on the results and experience of dredges now working. He endeavours in his short paper to compare the performances of the various dredges operated by his company. Details that might profitably be improved upon are dealt with and remedies suggested, these suggestions being given more as a basis of discussion than as a considered solution of the problem in hand.

Capacity of Bucket.—The bucket is the part round which, more or less, centres the whole design of the dredge. The yardage to be treated being known, the speed of the buckets is fixed, a percentage for running time and average content of bucket is assumed, and from this data the capacity of the bucket is arrived at.

Speed of Buckets.—It is usual practice to run close connected buckets at a speed of from 22 to 24 per minute and from observation it would appear that this is the limit with the type of top tumbler at present in use. At a greater speed it is probable that the tumbler would work loose on account of the rapidity of the bumping of buckets. An eight-sided tumbler might allow of considerable speeding up of the buckets while minimizing the bumping effect with its more gradual overturning of buckets. On the other hand it is doubtful whether it would give the sufficient heel or pull necessary to turn them.

Running Time.—The figure usually taken for running time on a monthly basis is 80%. The following table gives the mean percentage of twelve months on eight electrically driven dredges either new or very recently reconstructed:—

No. of Dredges.	*Size.*	*% Running Time.*
2	7 cu. ft.	88·6
2	9 ,, ,,	85·6
4	12 ,, ,,	78·0

The figure for the largest dredges compares unfavourably with those of the smaller machines but in extenuation some difficulties, peculiar to these dredges, might be enumerated.

(1) "Power Off" stoppages are more frequent and of longer duration on account of the greater length and lesser accessibility of the transmission line.

(2) Much heavier jungle is encountered with a consequent increase of timber to be dealt with.

(3) Parts of these dredges as originally supplied proved defective, resulting in abnormal stops, while the parts were being repaired or replaced. With these defects rectified the proportion of accidental stops should be greatly decreased.

(4) During several months excessive time was lost clearing discharge chutes of sand, but with a re-arranged water supply this has now been remedied.

Allowing for these unusual circumstances it may be assumed that the time spent on ordinary repairs and replacements will not be very much more than on the smaller dredges.

Capacity of Buckets.—The average capacity of the bucket is generally taken to be 65% of the theoretical capacity, although this figure would appear to be rather high when compared with the results obtained over a period of one year and set out in the following table:—

Size of Bucket.	*Average Capacity.*	*Average Depth.*
7 cu. ft.	48·5%	44 ft.
9 ,, ,,	50·0%	52 ,,
12 ,, ,,	54·0%	55 ,,

Again these figures can only be taken as averages, and higher and lower capacities fall to be recorded. A 7 cu. ft. dredge recently reconditioned has dug to 70% bucket capacity for the last four months at an average depth of 51 ft., while a 9 cu. ft.

dredge working shallow ground of 24 ft. has only dug 43% of its capacity.

Details of Buckets.—A necessary feature of a well designed bucket is that the lip should offer a certain measure of protection from scouring to the after parts of the bucket, that is the edge of the lip should cut the way clear for the parts following. Some buckets are unsatisfactory in this respect and at the sides the back portion of the lip and the rivets suffer undue wear. Some new buckets are fitted with what is called "an all clear full protecting lip" and appear not only to meet the requirements as stated above but seem also to fill and dump better than the other type. This bucket approximates more to the shape of a section of a cone with rounded end and is free from the square bottom and pockets noticeable on the present type. The inside face of the lip bearing on the bucket sides and back has a slightly spherical surface so that when drawn into position the lip fits tightly on the bucket, thus avoiding undue initial strain on the rivets. On the inside at the back the lip projects slightly above the surface of the bucket with the object of preventing clay from adhering too closely to the bucket and sticking there till the drop chute is passed. Buckets fitted with inside lips are being tried with the same object in view, namely better protection of the parts behind.

An unsatisfactory point about the bucket pin as at present fitted is the method of keeping it in position. The original idea of fixing it with a bolt through the flat head has been abandoned on account of the bolt shearing or working loose. At present taper keys of section 1¼ in. by ¾ in. are wedged between the edge of the pin head and the recess in the bucket. These work loose when the bucket is being dragged round the top tumbler as at this point the direction of pull on the pin is not in line with the axis of the key. In later buckets the recess for the pin head has been cast at an angle so that at the point where the pin is subjected to its greatest movement, the direction of the pull on the pin and the axis of the key will be more nearly in line. Another method was tried in which the key was replaced by a set pin screwed into the edge of the head and turned back till the head of the screw was bearing tight on the top edge of the recess. A mild steel set screw 1 in. aid. was fitted, but the thread allowed too much play and the screw bent. A nickel chrome set screw with finer thread was used, but failed also.

On one dredge it is proposed to make the pin head longer and an exact fit in the recess and to rely solely on this for keeping the pin in place. This will certainly prevent the pin from turning but still allows the possibility of a slight backward and forward movement of the pin in the front eye which in the course of time will show wear. To prevent this a projection might be made on the pin head to fit in a corresponding recess in the bucket, or the pin head slotted to engage with snugs on the bucket. Alternatively a slot might be cut across the pin head with slots above and below on the bucket and a key driven in to make the whole fast. The section of the key could be partly "V" shaped with the narrower face in front to prevent its falling out.

Bucket bushes, as at present fixed with a tapered top half cast-steel bush or wedge-block, soon work loose and thin steel wedges have to be driven between the wedge-block and the bucket to keep the bush from turning. Since these wedge-blocks fail so soon in their task or in keeping the bush in position it seems obvious that they should be abandoned in future buckets. The back eye of the bucket might be cast to suit a half bushing only. The bush might be a little short of the semi-circle leaving space on the top side for a key. The edges of the bush and the bucket eye could be chamfered slightly to keep the key from dropping down. These keys would not be expensive and stocks of varying sizes could be ordered as found necessary.

Allocation of Total Horse Power.—On the company's dredges the distribution is approximately as follows :—

Buckets . . .	28%
Pumps	32%
Winches . . .	20%
Screens and Jigs . .	15%
Miscellaneous . .	5%

Total Horse Power Required.—An attempt is made by the author to arrive at a figure for h.p. required per yard of material dredged. It will be realized that this figure will vary widely, grounds of a difficult nature demanding more power for digging and washing than is required for easier material. Further allowance must be made for dredges digging to a depth much greater than is usual on dredges of a similar capacity. The value given for the h.p. per yd. will be based, not on the theoretical capacity of the dredge, but on the working figure of 65%. It is assumed that the overload factor of the various motors will be capable of dealing with the extra load during the periods when a capacity greater than 65% is being treated.

Average figures taken from monthly returns show that the h.p. used per hour digging is as follows :—

7 ft. dredge	326 h.p.	40%	full buckets
9 ,, ,,	370 ,,	50%	,, ,,
12 ,, ,,	495 ,,	52%	,, ,,

Correcting these figures for a capacity of 65% by assuming that all extra power demanded will be from the bucket motor only, the following table may be compiled :

Size of Dredge.	*h.p. per hour.*	*Yards per hour.*	*h.p. per yard.*	*Total h.p. installed.*	*h.p. installed per yard.*
7	365	223	1·63	478	2·14
9	400	286	1·40	533	1·86
12	525	380	1·38	720	1·90

Horse Power of Bucket Motor.—The power required for the bucket motor may be divided under three heads :—

(1) Power required to elevate the material (neglecting friction).

(2) Power absorbed in overcoming friction on gearing and bucket line parts.

(3) Power required for digging the material.

In the course of reading the author has come across two formulae for the power required for bucket motors on harbour dredges :—

Formula A gives—

(1) as above = $\frac{2}{3}$
(2) ,, ,, = $\frac{1}{3}$
(3) ,, ,, = Remainder

} of total power.

Formula B is h.p. = $\frac{(F \times C \times D \times H) + K C)}{33,000}$

where F = h.p. factor = 1·5 for normal arrangement of gearing.

C = cu. ft. of material dredged per minute.
D = weight per cu. ft. to be lifted.
H = total height to be raised.
K = constant for soft mud = 4,950 lb. units = ·15 h.p. units.
for clay = 9,900 lb. units = ·30 h.p. units.
for hard clay = 13,200 lb. units = ·40 h.p. units.

The theoretical power required for elevating the material is given below for three sizes of dredges. The bucket line being an endless chain, the weight of the buckets may be neglected. The specific gravity of material dredged is taken as 2 and allowance

	7 cu. ft.	9 cu. ft.	12 cu. ft.
Estimated capacity (yards per month)	130,000	170,000	230,000
Dredging Depth	60 ft.	60 ft.	75 ft.
Approx. Deadweight (estimated)	850 tons	1,100 tons	1,500 tons
Total Horse Power installed	480	540	720
Pontoon.			
Length	166 ft.	176 ft.	200 ft.
Beam	42 ft.	48 ft.	55 ft.
Depth at Bow	7 ft. 6 in.	7 ft. 6 in.	9 ft. 6 in.
Depth at Stern	8 ft. 6 in.	9 ft. 0 in.	9 ft. 6 in.
Length of Well	96 ft.	114 ft.	118 ft.
Width of Well	6 ft. 0 in.	7 ft. 3 in.	7 ft. 10 in.
Buckets.			
Material	Cast Steel with Mang. Steel Lips.		
Centres of Eyes	2 ft. 6 in.	2 ft. 8 in.	3 ft. 0 in.
Overall height	2 ft. 11½ in.	3 ft. 3 in.	3 ft. 8 in.
Max. width	3 ft. 2½ in.	3 ft. 5 in.	3 ft. 9⅝ in.
Length of bush	1 ft. 5¼ in.	1 ft. 6 in.	1 ft. 7 in.
Material of bush	Manganese Steel.		
Dia. of Pin	5⅛ in.	5½ in.	6⅞ in.
Material of Pin	Forged Nickel Chrome Steel.		
Weight of one bucket unit	15 cwt.	20 cwt.	27 cwt.
No. of buckets on string	100	100	105
No. of buckets per minute	22	22	22
Speed of buckets ft. per minute	55	59	66
Theoretical yards per hour	342	440	587
Ladder.			
Centres	111 ft.	117 ft.	141 ft.
Depth of centre	6 ft. 0 in.	6 ft. 6 in.	7 ft. 6 in.
Centres of side plates	4 ft. 2 in.	4 ft. 8 in.	5 ft. 2 in.
Dia. of Upper Suspension Shaft	9 in.	11 in.	12 in.
Dia. of Lower Suspension Shaft	6¾ in.	6⅞ in.	7½ in. main 4½ in. aux'y.
Approximate Weight	55 tons	70 tons	116 tons
Bottom Tumbler.			
Material	Cast Steel Body, Hard Cast Steel Tread Plates and Manganese Steel Flange Plates.		
Dia. of Tread	4 ft. 0 in.	4 ft. 9 in.	5 ft. 9 in.
Dia. of Flange	6 ft. 0 in.	6 ft. 9 in.	7 ft. 9 in.
Dia. of Shaft over Sleeves	11 in.	15 in.	16 in.
Length of Bearing	1 ft. 4 in.	1 ft. 7 in.	1 ft. 10½ in.
Centres of Bearings	4 ft. 8⅜ in.	5 ft. 1¾ in.	5 ft. 11⅓ in.
Weight of Tumbler and Shaft	7½ tons	10½ tons	14½ tons
Ladder Rollers.			
Material of Shell	Hard Cast Iron.		
Pitch	6 ft. 0 in.	6 ft. 0 in.	6 ft. 0 in.
Dia. of Shell	15 in.	15 in.	18 in.
Dia. of Shaft	3¾ in.	3¾ in.	4½ in.
Top Tumbler.			
Material	Cast Steel Body with Manganese Steel Tread and Flange Plates.		
Depth over Flats	3 ft. 6½ in.	3 ft. 8 in.	4 ft. 2 in.
Length over Bosses	4 ft. 0 in.	4 ft. 8 in.	5 ft. 2 in.
Dia. of Shaft	1 ft. 1½ in.	1 ft. 3½ in.	1 ft. 4½ in.
Centres of Bearings	7 ft. 0 in.	8 ft. 0½ in.	8 ft. 10 in.
Size of Bearings	12 in. dia. by 21 in. long.	14 in. dia. by 25½ in. long.	15 in. dia. by 27½ in. long.
Weight of Tumbler and Shaft	7½ tons	9½ tons	14 tons
Ladder Hoist Gear.			
Type	Double Hoist		
Blocks	2 sets of 5 sheaves	2 sets of 6 sheaves	2 sets of 6 sheaves
Dia. of Pulleys (Rope Centres)	2 ft. 6 in.	2 ft. 6 in.	3 ft. 0 in.
Cir. of Hoisting Rope	4 in.	4 in.	4½ in.
Material of Pulleys	Cast Steel.		
Material of Bushes	Cast Iron.		

	7 cu. ft.	9 cu. ft.	12 cu. ft.
Material of Pins	Nickel Chrome Steel.		
Dia. of Pin	5 in.	5 in.	8 in.
Length of Bushes	4½ in.	4½ in.	5 in.
Thickness of Bushes	1½ in.	1½ in.	⅜ in.
Section of Main Links	9 in. by 3½ in.	10 in. by 3½ in.	10 in. by 3½ in.
Section of Auxiliary Links	none	none	7½ in. by 2 in.
Approx. weight of Up. and Low. Gear	12 tons	13 tons	16 tons
Ladder Winch.			
b.h.p. of Motor	60	75	110
r.p.m. of Motor	720	720	720
Speed Reduction	105	133	115
r.p.m. of Barrel Shaft	6·85	5·4	6·25
Speed of Rope (ft. per minute)	58·5	42·5	59
Dia. of Barrel	2 ft. 6 in.	2 ft. 6 in.	3 ft. 0 in.
Length of Barrel	3 ft. 9 in.	4 ft. 4 in.	4 ft. 0 in.
Dia. of Barrel Shaft	5 in. to 6½ in.	6 in. to 7¼ in.	6 in. to 7 in.
Main Gear.			
b.h.p. of Motor	130	150	200
r.p.m. of Motor	730	730	730
Speed Reduction	200	200	200
r.p.m. of Top Tumbler	3·65	3·65	3·65
Number of Crown Wheels	1	2	2
Particulars of Crown Wheels	120 teeth 3½ in pitch 11 in. face	120 teeth 3½ in. pitch 11 in. face	134 teeth 3¾ in. pitch 11 in. face
Approx. dia. of Crown Wheels	11 ft. 0 in.	12 ft. 0 in.	13 ft. 6 in.
Screen.			
Diameter	6 ft. 0 in.	7 ft. 6 in.	8 ft. 0 in.
Length of Perforations	24 ft. 0 in.	27 ft. 6 in.	36 ft. 0 in.
Centres of Paths	28 ft. 9 in.	33 ft. 6 in.	42 ft. 0 in.
Overall Length	34 ft. 6 in.	42 ft. 0 in.	50 ft. 0 in.
Slope	1 in 16	1 in 12	1 in 12
r.p.m.	8·6	7·0	6·5
Peripheral Speed (ft. per minute)	162	165	164
Particulars of perforations	¼ in. dia. 1¼ in. pitch	¼ in. dia. 1¼ in. pitch	¼ in. dia. 1¼ in. pitch
Horse power of Motor	35	35	50
Approximate Weight	15 tons	21 tons	31 tons
Jigs.			
No. of primary Jigs	10	12	14
No. of Cleaner Jigs	1	1	2
Speed of Primary Jigs (Strokes per min.)	110	110	110
Speed of Cleaner Jigs (per min.)	165	165	165
Pumps.			
Sparge Pump.			
Bore	13 in.	14 in.	16 in.
Gallons per minute	3,000	3,500	4,500
Horse Power of Motor	85	100	105
Jig Pump.			
Bore	18 in.	18 in.	20 in.
Gallons per minute	6,000	6,000	7,500
Horse Power of Motor	75	75	105
Extra Chute Pump.			
Gallons per minute	—	—	3,000
Horse Power of Motor	—	—	—
Concentrate Pump.			
Duty	Products of 2 Primary jigs and Cleaner Jig	Products of all jigs.	Products of 2 Cleaner Jigs.
Type	No. 6 Frenier	4 in. Gravel	No. 6 Frenier.
Capacity	4,500 gls. per hour.	7 cu. yds. solids per hour.	4,500 galls. per hour.

Table of Dredge Details.

is made for reduction of weight below the water line :—

Capacity of bucket cu. ft.	7	9	12
No. of buckets on string	100	100	105
No. climbing ladder	48	48	51
No. above water level	17	17	17
No. below water level	31	31	34
Speed of buckets ft./minute	55	58·6	66
Vert. height travelled per min.	38′	42·5′	46·7′
Weight of material (lbs.)	28,000	36,000	51,000
h.p.	$\frac{28{,}000 \times 38}{30{,}000}$ = 32	$\frac{36{,}000 \times 42{\cdot}5}{33{,}000}$ = 46	$\frac{51{,}000 \times 46{\cdot}7}{33{,}000}$ = 72

Substituting these figures in both Formulae.—

	Elevating.	*Friction.*	*Digging.*	*Total.*	*h.p. of Motor installed.*
7 CU. FT. DREDGE.					
A.	32	37	43	112	130
B.	32	16	62	110	
9 CU. FT. DREDGE.					
A.	46	52	63	161	150
B.	46	23	80	149	
12 CU. FT. DREDGE.					
A.	72	84	96	252	200
B.	72	36	106	214	

In formula B, K is taken as for hard clay.

The two formulae give fairly equal results for total h.p. required, but differ in the proportions allowed for friction and digging. From these tables it will be seen that, if raising the height of the top tumbler be deemed advisable for any reason, the extra power required on the bucket motor will not be very great. A little extra power will be required for elevating but the power required for the other operations (which absorb more than two thirds of the power) will remain practically as before.

SCREEN.—Since the peripheral speed of all the screens is the same, the effective screening area will be the arc subtended by the same angle on each screen. Hence it appears that the diameter of the screen ought to be directly proportional to the capacity of the bucket. The slope on all screens on the company's dredges is 1 in 12. The ratio of the length of perforations to the diameter of the screen is 4 on the 7 ft. dredges, 3·7 on the 9 ft. dredges, and 4·5 and 3·75 on the 12 ft. dredges. The larger ratio of 4·5 may be explained by the fact that on this dredge a longer length of screen hopper was required for better distribution to the jigs and lengthening the screen seemed at the time the simplest way of effecting this. Taking the average figures for ratios of diameter of screen to bucket capacity and diameter to length the resulting dimensions of the screens would be :—

Dredge.	*Diam.*	*Length.*
7 ft.	5 ft. 6 in.	22 ft.
9 ft.	7 ft. 0 in.	28 ft.
12 ft.	9 ft. 0 in.	36 ft.

SCREEN DETAILS.—The screen drive is at the top end of the screen on some dredges and at the bottom end on others. With the present arrangement of gearing, placing the drive at the bottom end certainly allows easier access to the driving gear, but on the other hand it is much more liable to be splashed with overflowing sand. Again, with the existing lay out of jigs on these dredges, the screen driving gear at the bottom prevents arranging of jig feed chutes to the best advantage. Placed at the top end, the drive will be much cleaner and will have the added advantage of being placed where the load is greatest, with a consequent reduction of the torsional stress on the screen. The disadvantage of inaccessibility might be overcome by re-arranging the drive so that the reduction gear is removed from the immediate vicinity of the driving gear. Eliminating the bevel gear and placing the drive athwartships is a suggested method of accomplishing such a re-arrangement. In any case the substitution of spur wheels for bevel wheels would be an advantage since the movement of the screen up or down is partly transmitted to the driving wheel thus preventing the gears from meshing properly.

The idling rollers are placed at an angle of 30°, this angle being found sufficient to keep the screen securely in position. Fixed further apart these rollers will offer unnecessary resistance to the revolving screen. Side thrust on the driving path is taken by two small rollers at the centre line of the screen and to support these, especially on the driving side, a fairly strong girder is required, this structure adding to the congestion already apparent in this crowded corner. On one dredge this small side thrust roller has been replaced by an idling roller fitted at 30° to the vertical centre line. A solid base for this roller is obtained by seating it on the girder carrying the driving roller. A small side thrust roller is fitted on the offside of screen as before. The paths should be fitted with renewable tread rings and where on account of size these tread rings are made in sections, the joint should be diagonal as when they are square there is a possibility of a flat being worn at the joint. The thrust roller pedestals should be adjustable to take up wear on the roller.

In cases where the distance between the screen hopper bottom and the screen shell is abnormally small, it seems advisable to fit angle iron ribs on the outside of the shell to prevent undue scouring of the shell plates.

NUMBER OF JIGS.—With similar grounds the number of jigs should be proportional to the screening area and consequently to the bucket capacity.

The ratio $\frac{\text{Yardage}}{\text{No. of jigs}}$ is not the same on all these dredges but taking the mean figure the arrangement of jigs would be as follows :—

Dredge.	*No. of jigs.*
7 cu. ft.	9
9 ,, ,,	12
12 ,, ,,	16

The width of the jig grid at present fitted is 3 ft. and that of plunger compartment about the same. Assuming that 6 in. is added to the width of the grid and a corresponding amount to the plunger compartment, then without altering the jigging area, the number of jigs as given in the table would be reduced by 1 on the 7 ft. dredge and 2 on the other dredges. Jigs built to these dimensions would certainly not be much more difficult to handle and would require very little extra stiffening. The driving parts for the plungers would be of practically similar to the present parts and no extra power would be required. Further, there would be a reduction in the total number of wearing parts with a consequent reduction in costs for spares. Assuming the pontoon to be of the same length, with such an arrangement of jigs a space of 3 ft. to 4 ft. would be saved at the stern of the dredge, a valuable space in such a congested area.

Titanium.—Although titanium was discovered 141 years ago, it is only within the past 10 or 15 years that any extensive outlet for its ores has been found. This recent increase in its use is due to the larger employment of titanium pigments. An account of the uses of titanium is given in Information Circular 6365 of the United States Bureau of Mines. The author of this circular, E. P. Youngman, says that titanium ranks as one of the more abundant elements. It is widely distributed and occurs in concentrated form in numerous deposits, although it can scarcely be said that the production or use of the metal itself has progressed very far beyond the laboratory stage.

Ferro-alloys containing the element were largely used for a time, especially in connexion with the manufacture of Bessemer steel rails, but as American railways adopted open-hearth rails in preference to Bessemer rails, the demand for the alloys in the rail manufacture gradually dwindled into insignificance. New outlets for ferro-titanium have been found in the steel industry, and the production of titanium alloys, both in the United States and in Europe, has increased in recent years. By far the largest use of titanium at the present time, however, is in pigments. The manufacture of titanium white began in Norway, but at present the United States is the leading producer. One of the two companies now operating in the United States is also the leading factor in European production.

Although titanium occurs in many minerals, the principal commercial sources are rutile and ilmenite. The latter is a coal-black mineral, but it is the one used in the manufacture of the titanium white of commerce, as well as in the manufacture of ferro-alloys and arc-lamp electrodes. Rutile, the natural oxide, is not pure white and, being less common in nature, costs more and it is, therefore, reserved for use in the manufacture of titanium chemicals employed in relatively small amounts in dye works and bleacheries and for sundry minor purposes.

Titanium is a rare element only in the sense that it does not occur in nature in easily recognized forms or in concentrates in quantities large enough to receive attention. In its properties it closely resembles cerium, thorium, zirconium, and the recently discovered hafnium, and it is related to the family to which silicon, tin, lead, and germanium belong.

Titanium, in the amorphous form, is a dark-grey powder, resembling reduced iron. In the crystalline form it is isomorphous with zirconium and silicon. The fused metal, resembling polished steel, is hard enough to scratch quartz; although it possesses little ductility (when cold it may be easily powdered), when prepared properly it is readily worked and at red heat may be forged and drawn. The surface when fractured has a brilliant lustre, sometimes with a bronze-yellow tint. It is paramagnetic and when rubbed against steel it emits bright sparks. It forms alloys with most of the metals, but especially with copper, tin, iron, aluminium, chromium, cobalt, molybdenum, and tungsten.

Titanium and its compounds are employed chiefly in the manufacture of pigments (paints) and of metallic alloys (principally ferro-titanium) for use in the metallurgy of iron and steel. Other lesser but also important uses include titanium salts as reducing or stripping agents and as mordants in the dyeing industry (textiles and leather), as a refractory pigment in the ceramic industry, and as incandescent media. Certain titanous salts act as acid-reducing agents, and titanous sulphate is used in decolourizing old paper and dyed fabrics and in detecting copper in dyed goods and fluorine in analytical work. Titanous chloride has its use in removing iron stains in laundries and in clearing goods that have run in the washing, while titanium dioxide is used in the manufacture of catalysts used in the esterification of acetic acid. Logwood-titanium compound is used in making a permanent ink, deep-blaek in colour, which undergoes no change after using and certain salts, especially the sulphates and salicylates, are useful in therapeutics. Titanium nitride is used as a basis for fertilizers and titanium tetrachloride in forming smoke screens while titanium has been used in pyrotechnics.

Rutile has been used in the manufacture of glass and some rutile crystals have value as semi-precious stones—these coming principally from Graves Mountain (Georgia), western North Carolina, San Benito County (California), and Brazil. A titaniferous emery from Pittsylvania County, Va., is said to have commercial value as an abrasive while a quick-hardening and chemically resistent cement has been obtained as a by-product of smelting titanium-iron ores in a blast furnace or an electric furnace, limestone being used as a flux. Rutile has been mined commercially in the United States, and Norway only. Even in these countries the production of this mineral has been relatively small and sporadic, seldom exceeding 200 tons in any single year.

The production of ilmenite has increased rapidly in the last few years, because of the ever-growing demand for titanium pigments. At present by far the bulk of the world's supply comes from British India, where it is associated with monazite deposits of the Travancore State. Norway is the second leading source of ilmenite, producing in 1928 an output of 7,948 tons, as compared with only 4,200 tons in 1926. The rate of increase, however, is much less than that reported for India, which contributed 25,713 tons in 1928, as compared with 4,304 tons in 1926. Senegal and Brazil also are important producers of ilmenite, but the available statistics indicate, in the case of Senegal at least, a declining production. The production of ilmenite in Canada jumped from 181 tons in 1926 to 2,036 tons in 1928 and 2,493 tons in 1929. That of Portugal declined from 1,030 tons in 1926 to 703 tons in 1928. Although no production figures with respect to Czecho-Slovakia are available, that country has been listed with the principal titanium-ore producing countries of the world, and in 1928 it shipped to New York City 1,805 tons of ore, valued at $32,490.

Although a number of alloys of titanium with other elements have been tested for different purposes, the only alloys that have been recognized as articles of commerce are the iron-titanium alloys (ferro-titanium and ferro-carbon-titanium), cupro-titanium, and mangano-titanium; and of these only the iron-titanium alloys are at present on the market. The quantity of titanium alloy added per ton of steel is usually small, often only a pound, and rarely exceeding 13 lb. (perhaps 0·1% of metallic titanium), but titanium treatment tends to produce better steel, particularly with

regard to homogeneity and freedom from blow-holes.

The titanium-pigment industry is of recent growth but is fast becoming of great importance. The increased use of lacquers has been a factor in its growing use. Lacquers have supplanted paint in the motor industries, paint having almost disappeared in the coating of non-moving metal parts of innumerable kinds of machines and metal wares; and lacquers are being used in increasing amounts in woodwork and interior decoration also. Special mixtures of lithopone and titanium dioxide in suitable vehicles are used in many lacquers.

SHORT NOTICES

Power-Shovel Mining.—Information Circular 6383 of the United States Bureau of Mines contains a paper by Scott Turner, on mining bituminous coal by stripping methods, which was originally presented at the second World Power Conference held in Berlin this year.

Pneumatic Picks.—A novel mining hammer is described by J. Maercks in *Gluckauf* for October 11.

Mechanical Plant at Tetiuhe.—The plant at the lead-zinc mines at Tetiuhe, Siberia, is described by Dr.-Ing. Wölbling in *Metall und Erz*, 1 Octoberheft.

Mining Swedish Iron Ore.—The mining and transport of Swedish iron ore is described by B. H. Strom in *Engineering and Mining World* for October.

Working of Iron Ore.—T. L. Joseph and E. P. Barrett give the results of an investigation which set out to determine the decrease in size of iron ores inside blast furnaces, in Technical Publication No. 372 of the American Institute of Mining and Metallurgical Engineers.

Steel Roof Supports.—In a paper read before the Midland Counties Institution of Engineers at Nottingham on October 22, C. Dickinson and F. A. Hatfield dealt with the progress made in the use of steel roof supports during experimental work at Netherseal Colliery.

Schaefer Lining System.—The *Iron and Coal Trades Review* for November 14 contains a summary of a lecture on " The Schaefer lining in general, with particular reference to British Schaefer spaced ring " which was given by Lt.-Col. Godfrey Jones to the Midland Branch of the National Association of Colliery Managers.

Ore Drying.—The first part of an article on the heating and drying of granular materials by convection by W. Gilbert, appears in the *Engineer* for November 7.

Flotation Reagents.—A paper on flotation reagents, by B. W. Holman, appears in the *Bulletin* of the Institution of Mining and Metallurgy for November.

Tin Metallurgy.—A. S. Fitzpatrick and H. S. Elford write on " Tin Metallurgy in Great Britain —1929," in the *Proceedings* of the Australian Institute of Mining and Metallurgy for June 30 last.

Milling Methods at the Presidio Mine, Texas.—Van Dyne Howbert and F. E. Gray describe the milling methods and give the costs at the Presidio mine of the American Metal Company of Texas in Technical Publication No. 368 of the American Institute of Mining and Metallurgical Engineers.

Milling Practice at San Francisco Mines of Mexico.—Technical Publication No. 371 of the American Institute of Mining and Metallurgical Engineers contains a description of milling practice at San Francisco Mines of Mexico by Glenn L. Allen.

Lead Recovery from Waste.—The electrolytic recovery of lead from lead sulphate waste is dealt with by C. G. Fink and L. Greenspan in a paper presented to the American Electrochemical Society on September 27.

Gold Metallurgy.—Developments in gold metallurgy during the past 50 years are reviewed by A. K. Anderson in the *Canadian Mining Journal* for October 10.

Concentration Methods at Chihuahua.—In *Mining and Metallurgy* for October, A. J. Monks and N. L. Weiss describe the concentration of oxidized lead ores at San Diego mill, Chihuahua, Mexico.

El Paso Refinery and Smelting Works.—F. R. Corwin and S. Harloff describe the El Paso refinery and E. R. Marble deals with natural gas firing at El Paso Smelting works in *Mining and Metallurgy* for October.

Kennecott Copper Deposits, Alaska.—S. G. Lasky in a paper appearing in *Economic Geology* for November attributes a colloidal origin to some of the Kennecott ore minerals.

International Nickel.—The *Engineering and Mining World* for November is a special number devoted to the International Nickel Company of Canada. Articles have been contributed on:—The Staff, by J. L. Agnew; Historical Notes, by E. A. Collins; Research, by A. J. Wadhams; Safety Work, by E. A. Collins and G. S. Jarrett; Sudbury Ore, by J. C. Nicholls; Mining Operations, by Oliver Hall; Creighton Mine, by R. D. Parker; Frood Shaft No. 3, by A. F. Brock; Deep Mining at Frood, by H. J. Mutz; Levack Mine, by A. L. Sharpe; Frood Equipment, by D. Butchart; Construction, by J. H. Brace; Plant Design, by L. M. Sheridan; Flotation, by W. T. MacDonald; New Smelter, by D. MacAskill and R. M. Coleman; Coniston Smelter, by W. A. MacDonnell and J. F. Robertson; Chemical Production, by J. M. Malcolm; Electric Power, by W. E. Gillespie; Port Colborne Plant, by R. L. Peek; Bayonne Foundry, by E. S. Wheeler; Ontario Refinery, by C. H. Aldrich and J. K. Bryan; Huntington Mill, by H. S. Arnold and A. S. Shoffstall; and Mond Operations, by the Mond Staff.

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.*

11,052 of 1929 (309,594). Electro Metallurgical Co., New York. A low-carbon silicide or silicon alloy of chromium, manganese, or vanadium, is brought into a self-propagating reaction, substantially without external heating, with an excess of an oxide of the particular metal, whereby the metal can be recovered and silicide for further use recovered from the slag.

21,208 of 1929 (336,007). I. G. Farbenindustrie A.-G., Frankfort-on-Main, Germany. Improvements in the manufacture and production of finely divided metals as metal carbonyls.

21,225 of 1929 (336,584). R. S. Carreras, Barcelona, Spain. Complex ores of copper, cobalt and nickel are subject to a combined leaching-roasting process prior to the electrolytic recovery of the individual metals.

31,740 of 1929 (336,109). A. MOZER. Berlin-Friedenau, Germany. The electrolysis of cuprous solutions.

94 of 1930 (335,852). METALLGESELLSCHAFT A.-G., Frankfort-on-Main. Sulphide ores are treated by adding fritting agents to them and subjecting them to a pre-roasting treatment for the purpose of fritting the fine ore particles together, to produce a grain size suitable for further treatment.

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.

Compressed Air Plant. By ROBERT PEELE. Cloth, octavo, 534 pages, illustrated. Price 37s. 6d. London: Chapman and Hall.

The Metallurgists and Chemists Handbook. By DONALD M. LIDDELL. Third edition, revised and enlarged. Pocket size, 847 pages. Price 25s. London: McGraw Hill.

The Chemical Analysis of Rocks. By Dr. H. S. WASHINGTON. Fourth edition, rewritten and enlarged. Cloth, octavo, 296 pages. Price 20s. London: Chapman and Hall.

The Metallurgy of the Non-Ferrous Metals. By W. GOWLAND. Fourth edition, revised by C. O. BANNISTER. Cloth, octavo, 633 pages, illustrated. Price 30s. London: Charles Griffin.

Verwertung magnetischer Messungen zur Mutung. By Dr. A. NIPPOLDT. Cloth, octavo, 74 pages, illustrated, with 36 tables. Price 16·50 R.M. Berlin: Julius Springer.

Mining Physics and Chemistry. By Dr. J. W. WHITAKER. Second edition. Cloth, octavo, 268 pages, illustrated. Price 9s. London: Edward Arnold.

Tables for the Determination of Minerals. By Dr. E. H. KRAUS and Dr. W. F. HUNT. Second edition. Cloth, octavo, 266 pages, illustrated. Price 15s. London: McGraw Hill.

How Some Firedamp Explosions are Prevented. What every Mining Man Should Know, No. 3. Issued by the Safety in Mines Research Board. Paper backs, 30 pages, illustrated. Price 3d. London: H.M. Stationery Office.

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology: 1929. Part III. Paper backs, 89 pages, illustrated. Price 2s. 6d. London: H.M. Stationery Office.

Investigations of Fuels and Fuel Testing, 1928. Canadian Department of Mines Testing and Research Laboratories. Paper backs, 71 pages, illustrated. Paper No. 712. Ottawa: Department of Mines.

Montana: Geology and Mineral Resources of parts of the Carbon, Big Horn, Yellowstone, and Stillwater Counties. United States Geological Survey Bulletin 822–A. Paper backs, 70 pages, illustrated, with map. Price 25 cents. Washington: Superintendent of Documents.

Mineral Resources of the United States, 1929. Part II, pp. 35–40, Silica; pp. 41–49, Graphite, by J. MIDDLETON; pp. 51–59, Carbon Black, by G. R. HOPKINS and H. BACKUS; pp. 61–64, Fuller's Earth, by J. MIDDLETON. Paper covers, each part 5 cents. Washington: Superintendent of Documents.

COMPANY REPORTS

Van Ryn Gold Mines Estate.—This company was formed in 1894 and works a gold mining property in the Far East Rand. The report for the year ended June 30 last shows that 640,395 tons of ore was mined and, after sorting out 24·17% of waste, 487,800 tons was sent to the mill, where 114,153 oz. of gold was recovered. The revenue from milling operations was £488,100, or 20·01s. per ton, and the working costs £442,861, or 18·15s. per ton, leaving a working profit of £45,239. Sundry revenue brought in £16,721 and the gross profit was £61,960, from which dividends totalling £25,000, equal to 5%, were paid. The payable ore reserves at the end of the period under review amounted to 765,088 tons averaging 4 dwt. in value over a stoping width of 44 in., as compared with 961,944 tons, averaging 4·3 dwt., at the end of the previous year. Development work during the year was confined almost entirely to the upper leaders and about 50% was carried out on the "170 ft. reef" horizon in No. 4 mine.

Luipaard's Vlei Estate and Gold.—This company was formed in 1888 and works gold-mining properties in the Far West Rand. The report for the year ended June 30 last shows that 294,800 tons of ore was sent to the mill where 75,064 oz. of gold was recovered, worth £317,978, or 21s. 7d. per ton. Working costs amounted to £284,152, or 19s. 3d. per ton, and the working profit to £33,827. Sundry revenue brought in £12,162, so that the total profit for the year was £45,988, as compared with £48,852 in the previous year. After allowing for Miners' Phthisis Act liability and other charges the net profit was £37,033, which added to the balance brought forward, made an available total of £83,533. Of this amount, £75,000 was transferred to reserve and the balance of £8,533 carried forward. The ore reserves at the end of the year were estimated to be 1,028,100 tons, averaging 5·4 dwt. over a stoping width of 41·2 in., an increase of 149,100 tons in amount over the previous year while the average value is unchanged. Development work at depth continues to be satisfactory and on the upper levels reclamation work was successful in opening up several payable blocks of ore on both reefs. In the beginning of January last two-stage hoisting was successfully completed at the vertical shaft, considerably increasing the hauling capacity.

Lydenburg Platinum Areas.—This company was formed in 1925 and works platinum properties in the Lydenburg district of the Transvaal. The report for the year ended June 30 last shows that 41,900 tons of ore was treated during the year, as compared with 41,465 tons in the previous year, the recovery being 8,743 fine oz. of platinum group metals, against 8,510 oz. the year before. Working costs were increased from 24s. 8d. to 27s. 3d. per ton, mainly owing to increased development and the greater depth of working. The amount realized by platinum sales during the year was £78,903, as compared with £105,951 in the previous year. The ore reserves were estimated to be 118,070 tons, averaging 4·2 dwt. Working operations resulted in a credit balance of £19,122, which, with £23,110 available from the previous year shows a total of £42,233. A dividend of 6½% absorbed £14,600 and, after allowing for loss on concentrates due to the fall in the price of platinum and for other expenses, there remained a balance

of £9,087 to be carried forward. A circular issued to shareholders on November 15 last stated that the mines would cease operations on November 30 until conditions improve in the platinum market.

Messina (Transvaal) Development.—This company was formed in 1905 and owns copper properties in the Transvaal. The report for the year ended June 30 last shows that the total ore production, including ore from development, amounted to 268,188 tons, averaging 2·75% copper, of which the Harper mine produced 93,945 tons and the Messina 174,243 tons, as compared with 248,385 tons in the previous year. The tonnage treated at the concentrator was 276,207, yielding 17,737 tons of hand-picked ore and concentrates, averaging 39·81% copper. At the smelting plant 6,800 tons of copper ingots was produced, as compared with 6,341 tons the year before. The profit for the year was £148,921, and £50,000 was distributed as dividends, equal to 1s. per share. The ore reserves at the end of the year were estimated to be 1,022,524 tons, averaging 2·75% copper, together with 132,788 tons of " probable " ore, averaging 2·93% copper.

Wankie Colliery.—This company was formed in 1899 to develop coal deposits in Rhodesia and further properties have been acquired from time to time. The report for the year ended August 31 last shows that the sales of coal amounted to 855,088 tons and of coke, 97,855 tons, as compared with 816,296 tons and 100,293 tons respectively in the previous year. The increase in coal sales was due to increased fuel orders from the Rhodesian and South African railways and from the Northern Rhodesian mines and these offset a reduction in orders from the Belgian Congo. The estimated coal reserves (exclusive of the new colliery) proved by actual development were 11,098,000 tons, an increase of 703,168 tons on the estimate of the previous year. During the year under review, 384,808 tons of coal was raised from the new (No. 2) colliery, which had, at August 31, a capacity of 40,000 tons per month, an amount which will be increased to 65,000 tons by February next. The sinking of the second inclined shaft was commenced on this mine in March last, and had been sunk 848 ft. by the end of the financial year. There was a profit on the year's working of £189,808 and £174,224 was distributed as dividends, equal to 17½%.

Jantar (Nigeria).—This company was formed in 1912 to acquire alluvial tin properties in Northern Nigeria. The report for the year ended September 30 last shows that 374½ tons of tin concentrates was recovered, as compared with 475 tons in the previous year, the reduction being due to restriction in accordance with the Tin Producers' Association scheme. To the output for the year the Jantar area contributed 203 tons, the Kuru I area, 136 tons and the Kuru III area, 35½ tons. The average working costs of the concentrates at rail-head was £70 9s. 1d. The ore reserves at the end of September were estimated to be 2,444½ tons. The year's working resulted in a loss of £642, reducing the credit balance to be carried forward to £14,020.

European and North African Mines.—This company was formed in 1927 and works lead, iron and zinc properties in Morocco. The report for the year ended September 30 last shows that 1,360 tons of lead concentrates was shipped during the period, the lead washing plant operating regularly. Shipments of iron ore amounted to 25,614 tons, the production for the year showing a considerable increase. Operations at the mine show a profit of £6,243, but after allowing for other charges and the difference of exchange there remained a loss of £1,274 to be carried forward. Steady progress was made during the period under review, and the iron mine is now able to produce at the rate of 50,000 tons annually.

Mount Elliott.—This company was formed in 1907 and owns copper properties in North Queensland. In 1929 an interest was acquired in the South American Copper Company. The report for the year ended June 30 last shows that on the Queensland properties tributors produced and sold during the year 7,933 tons of ore, averaging about 21% copper, which, after deducting all charges, realized £70,674. The net receipts to the company were £10,874 and it is estimated that but for the collapse in copper prices a profit would have been realized. The progressive programme of assisted tributing at the company's mines at Cloncurry is to be continued. The company has agreed to increase its interest in the South American Copper Company where developments have recently been very favourable.

Burma Corporation.—This company was formed in 1919 to acquire the undertaking of Burma Mines, Ltd., and works a group of silver-lead, zinc and copper mines at Bawdwin in Upper Burma. The report for the year ended June 30 last shows that the output of refined lead and silver for the year amounted to 79,267 tons and 7,254,780 oz. respectively, as compared with 78,716 tons and 7,376,841 oz. in the previous year. During the year 500,585 tons of ore was extracted having an average assay value of 21·5% lead, 11·6% zinc, 1·27% copper and 18·7 oz. silver per ton, as compared with 463,057 tons averaging 22·6% lead, 12·9% zinc, 1·07% copper and 19·7 oz. silver per ton, in the year before. In addition to the lead and silver produced, 57,325 tons of zinc concentrate, averaging 52·37% zinc, 4·24% lead and 8·10 oz. silver per ton, was shipped to Europe, and 4,933 tons of nickel speiss, 12,904 tons of high-grade copper matte and 1,513 tons of antimonial lead recovered from the blast furnaces. The ore-reserves at the end of the year were estimated to be 4,265,665 tons, averaging 25·5% lead, 15·3% zinc, 0·88% copper and 20·4 oz. silver per ton, as compared with 4,140,969 tons, averaging 25·9% lead, 15·8% zinc, 1·05% copper and 21·2 oz. silver per ton, at the end of the previous year. The net profit for the year amounted to Rs. 92,48,040, to which must be added Rs. 27,09,953 brought forward from the previous year, making an available total of Rs. 1,19,57,993. Of this amount Rs. 1,10,02,622 was distributed as dividends, equal to 13 annas per share.

Anglo-Burma Tin.—This company was formed in 1926 and works alluvial tin properties in the Tavoy and Mergui districts of Lower Burma. The report for the year ended June 30 last shows that there was a total output of tin concentrates amounting to 238·8 tons, of which 196·9 tons came from the Heinda plant, which treated 395,367 cu. yd. of ground during the year. The total output for the previous year was 151 tons. The year's working resulted in a net loss of £1,179.

Pahang Consolidated.—This Company was formed in 1906 to acquire lode-tin mines in the State of Penang, F.M.S. The report for the year ended July 31 last shows that 186,050 tons of ore was milled for a yield of 2,662 tons of tin con-

centrates, and that 35·5 tons of alluvial tin was also recovered, bringing the total output up to 2,698 tons, as compared with 2,579 tons in the previous year. The profit for the year was £63,693, from which £9,500 has been distributed to preference shareholders and £46,875 to holders of ordinary shares, equal to 12½% on the latter. The lower profits are entirely due to the fall in the price of tin, the concentrates produced realising £29 per ton less than in the year before. Development has been continued with satisfactory results and new lodes have been located east of the main fault, an additional 3,437 ft. of payable ore being exposed. In addition, a new ore-body has been found at the 800 and 900 ft. levels.

Tekka.—This company was formed in 1920 and works an alluvial tin property in the Kinta District, F.M.S. The report for the year ended March 31 last shows that 540 tons of tin concentrates was won, as against 563 tons in the previous year. The profit for the year was £37,216 and £26,893 was distributed as dividends, equal to 1s. 6d. per share.

Kepong Dredging.—This company was formed in 1923 and works alluvial tin properties in the State of Selangor, F.M.S. The report for the year ended June 30 last shows that 8·218 acres of ground was dredged and 819,100 cu. yd. of ground treated, yielding 431 tons of tin ore. The amount realized was £43,948, after deducting £3,822 paid as tribute, and the total expenditure was £28,333, leaving a mine profit of £15,615. The average price per ton of concentrates was £101 18s. 9d., as compared with £123 7s. 8d. in the previous year. Two dividends paid during the year absorbed £6,750, equal to 5% and, after providing for depreciation the balance of £2,350 was carried forward. With object of conserving the reserves of tin ore the dredge was closed down on October 31 last, working being suspended until the price of tin warrants a recommencement.

Pari Tin.—This company was formed in 1922 as a reconstruction of Tronoh South, Ltd., and operates alluvial tin properties in the Chemor district, F.M.S. The report for the year ended June 30 last shows that 106,531 cu. yd. of ground was treated, an increase of 31,217 cu. yd. over the previous year, and 31·1 tons of tin concentrates recovered, as against 32·17 tons. The output realized £3,237, equivalent to £104·07 per ton, as compared with £129·7 the year before. The profit for the year, after providing for depreciation, was £1,402, to which must be added the balance of £3,260 brought forward, making an available total of £4,662. Dividends amounting to 7½% absorbed £1,875 and the balance of £2,787 was carried forward.

Ayer Hitam Tin Dredging.—This company was formed in 1926 and works alluvial tin property in the State of Selangor, F.M.S. The report for the year ended June 30 last shows that the dredge commenced settled production in November, 1929, and up to the end of the period under review had produced 562·7 tons of concentrates, which realized £59,779. The profit for the year after providing for depreciation was £17,236 and, after deducting the debit balance of £12,450 bought forward, there was a net profit of £4,786, of which £4,500 was distributed as a dividend, equal to 22½%. The company is now restricting output in accordance with the scheme of the Tin Producers' Association.

Kampar Malaya Tin Dredging.—This company was formed in 1927 and works alluvial tin properties in the Kinta district, F.M.S. The report for the year ended April 30 last shows that 726 tons of tin concentrates was recovered from the treatment of 2,121,371 cu. yd. of ground dredged from 27·1 acres. The dredge, completed in April 1929 and commencing profitable production in June of the same year, has given every satisfaction, the throughput for the first two months of the current year exceeding 394 cu. yd. per hour. The working costs amounted to £33,382, or £45 19s. per ton of concentrates and the net working profit was £39,360, or £54 per ton. The company has pursued a policy of regulation in accordance with the recommendations of the Tin Producers' Association. Dividends equal to 10% absorbed £15,907.

Sione Tin.—This company, formed in 1927, works an alluvial tin property near Kuala Lumpur, F.M.S. The report for the year ended July 31 last shows that 25·62 acres was worked and 1,308,547 cu. yd. of material treated. yielding 330 tons of tin concentrates. Operations resulted in a working profit of £7,216, to which must be added £2,513 brought forward. After allowing for depreciation and other charges there remained a balance of £212 to be carried forward. The tin concentrates recovered continued to be of exceptional purity, assaying 76·09% tin, and they realized the high average price of £168 17s. 1d. per ton.

Santa Gertrudis.—This company was formed in 1909, as a subsidiary of Camp Bird, Ltd., to operate a silver mine at Pachuca, Mexico. Work on the Santa Gertrudis property ceased in 1925, and the company now works a group of neighbouring mines. The report for the year ended June 30 last shows that during the year the mill of the Cia Beneficiadora de Pachuca treated 584,770 dry tons of ore having a gross assay value of $5,349,340. Of this ore 204,275 tons was produced by the Inversiones Company and 380,495 by the Dos Carlos Company. The bullion recovered contained 36,875 oz. gold and 8,958,126 oz. silver. The gross profits for the year were £328,784, or £18,230 more than in the previous year. After providing for expenses there remained a balance of £317,523, of which £233,010 was distributed as dividends, equal to 3s. per share. Developments on the Dos Carlos group continued favourable, a new rich vein, the Mariposa, being discovered.

Camp Bird.—Originally formed in 1900 to work a gold mine in Colorado, this company has now other interests, including the Santa Gertrudis mine in Mexico and the Lake George mine in N.S.W. The report for the year ended June 30 last shows that the lessees of the Camp Bird mine have paid £7,207 in royalties on ore produced during the year. Operations at Santa Gertrudis are reviewed elsewhere. The company's interest in the Mexican Corporation, whose report is also reviewed in these columns, have also yielded a profit. At the Lake George mine work has been largely confined to bringing the property to the production stage. The new main shaft has been sunk to the 6th level and this is being extended through the central ore-body previously developed only by diamond drilling. The pilot plant gave satisfactory results, and on these the designs and estimates for the main plant have been practically completed. The property has, however, in view of the base-metal situation, been temporarily closed down. At the time of closing down the ore-reserves were estimated to be 2,000,000 tons, averaging 7·5% lead, 12·9% zinc, 0·75% copper, and 2·2 oz. silver and 1·28 dwt. gold per ton. The results of the Durango timber company showed a substantial improvement in

production, sales and profits, while the Creole Petroleum Corporation also had a profitable year. The company's profit for the year was £134,719, and after adding the balance of £149,993 brought forward and £5,588 from share premium reserve there was an available total of £290,300, of which £100,000 was transferred to reserve, £51,970 used as preference dividends, and £117,014 used for debenture interest and other expenses. The balance of £73,286 was carried forward.

Mexican Corporation.—This company, formed in 1919, is interested in the Teziutlan copper-zinc property in Puebla and also in the Fresnillo silver mine, Zacatecas, Mexico. The report for the year ended June 30 last shows that at Fresnillo the cyanide mill treated 825,876 tons of oxide ore, averaging 0·13 dwt. gold and 6·16 oz. silver per ton, the bullion produced containing 3,948 oz. gold and 3,771,033 oz. silver. The pre-treatment of manganese silver ore by the McCluskey process had to be abandoned during the year, as the price of silver did not compensate for the added cost of the method. The concentrator treated by selective flotation 251,278 tons of sulphide ore averaging 8% lead, 8·5% zinc, 0·70% copper, and 10·42 oz. silver and 0·43 dwt. gold per ton, producing 35,427 tons of lead concentrates, 31,307 tons of zinc concentrates, and 10,881 tons of iron concentrates. The ore-reserves at the end of the period under review were estimated to be 1,265,000 tons of oxide ore, averaging 5·95 oz. silver and 0·13 dwt. gold per ton, and 968,194 tons of sulphide ore, averaging 9·3% lead, 9·8% zinc, 0·6% copper, and 10·0 oz. silver and 0·4 dwt. gold per ton. At the Teziutlan mine the concentrator treated 63,670 tons of sulphide ore, averaging 3·07% copper, 12·13% zinc, 1·19% lead, and 2·4 oz. silver and 0·5 dwt. gold per ton, producing 8,501 tons of copper concentrates and 9,805 tons of zinc concentrates. The ore-reserves at this mine were estimated to be 128,120 tons, averaging 3·3% copper, 12·0% zinc, 1·0% lead, and 2·3 oz. silver and 0·5 dwt. gold per ton. The gross profits of the Mexican Corporation for the period under review were £68,499, of which £50,000 was distributed as a dividend, equal to 1s. per share.

Trepca Mines.—This company was formed in 1927, and is working the Stantrg lead-zinc mine in Yugoslavia. The report for the year ended September 30 last shows that the mill was completed in August last, production commencing a month in advance of the estimated date, and the plant is now working smoothly and well. Development during the year was confined principally to preparing the mine for stoping. During the short period during which the plant was running it treated 17,371 tons of ore, averaging 9·6% lead and 8·1% zinc, yielding 2,229 tons of lead concentrates, averaging 70% lead and 24 oz. silver and 1·4 grams gold per ton, and 1,003 tons of zinc concentrates, averaging 47·6% zinc. The mill operations were conducted at a profit of £2,221, which was carried forward.

Jantar (Cornwall).—This company was formed in 1927 and works the Porkellis tin mine near Helston, Cornwall. The report for the year ended March 31 last shows that 27,925 tons of ore was milled, yielding 288 tons of black tin, the costs working out at 19s. 11½d. per ton milled. After providing £2,326 for depreciation and writing off £2,500 for mine development and construction, there remained a loss on the year's working of £3,372. The ore-reserves at the end of the year were estimated to be 95,760 tons, averaging 29·61 lb. black tin per ton. Since the end of the year under review, the continued fall in the price of tin has forced the management to close down the mine.

Weardale Lead.—This company has worked lead mines in Weardale, County Durham, since 1883. The report for the year ended September 30 last shows that 3,785 tons of lead concentrates and 6,895 tons of fluor spar were produced, as compared with 4,144 tons, and 7,777 tons, respectively, in the previous year. There was in addition 173 tons of lead ore from mines in the company's royalty area worked for other minerals. Of the galena produced, 1,892 tons was obtained from the Allendale mines, full operation at this property, following the fire which destroyed the dressing plant in 1929, being resumed at the end of January last. The Boltsburn mine produced 1,768 tons of galena and 68 tons came from the Sedling mine. The profit for the year was £4,380 and £2,448 was distributed as a dividend, equal to 6d. per share.

British Burmah Petroleum.—This company was formed in 1910 to acquire oil lands in the Yenangyaung field, Burma, and a refinery at Rangoon. The report for the year ended July 31 last shows that the production of crude oil has again declined in spite of the drilling of new wells. Any substantial increase in the quantity of oil won will be dependent upon the results of tests now being made on the areas of the Salay and British Burma Deep Drilling Companies. The net profit for the year was £136,404, from which £86,943 was distributed as dividends, equal to 6½d. per share, as compared with 7½d. per share in the previous year.

DIVIDENDS DECLARED

Anglo-Persian Oil.—5%, less tax, payable December 22.

British Burmah Petroleum.—5d., tax free.

Chinese Engineering and Mining.—4%, free of income tax.

Consolidated Gold Fields of South Africa.—1s. 6d., less tax, payable December 11.

Crown Diamond Mining and Exploration.—3d., less tax, payable December 30.

Griqualand Exploration.—4⅘d., less tax.

International Nickel.—25 cents, less tax, payable December 31.

Kaduna Syndicate.—1½d., less tax, payable December 17.

Kampar Malaya.—3d., less tax, payable November 29.

Kramat Pulai.—1s., less tax, payable December 20.

Lonely Reef Gold.—2s., less tax, payable January 31.

Marmajito Mines.—Pref. 2s., Ord. 1s., less tax, payable December 31.

Santa Gertrudis.—1s. 6d., less tax, payable January 8.

South-West Africa.—1s. 6d., less tax, payable December 11.

Taquah and Abosso.—3d., less tax, payable December 16.

Vereeniging Estates.—1s., less tax, payable January 28.

Wankie Colliery.—5%, less tax, payable November 25.

Zinc Corporation.—Pref. 2s. 9d., Ord. 9d., less tax, payable January 2.

COMPANY MEETINGS AND REPORTS SECTION

CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LTD.

Directors: Lord Brabourne (*Chairman*), J. A. Agnew, E. Birkenruth, D. Christopherson, S. Christopherson, Sir P. Cunliffe-Lister, O. V. G. Hoare, J. H. C. E. Howeson, Capt. M. H. Knatchbull, D. O. Malcolm, H. C. Porter, J. C. Prinsep. *Joint Secretaries:* J. Bradshaw and H. G. Sidgreaves. *Office:* 49, Moorgate, London, E.C. 2. *Formed* 1892. *Capital issued:* £6,251,310.

Business: Finance of and investment in mining and other properties in South Africa and elsewhere.

The ordinary general meeting of the Consolidated Gold Fields of South Africa, Limited, was held on December 2, 1930, at River Plate House, Finsbury Circus, London, E.C., Lord Brabourne (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended June 30 last, said: Taking first the accounts of the New Consolidated Gold Fields, the operating company, the gross profit earned in the year was £504,831, as compared with £930,127 in the previous year, the total profit on sales of investments having amounted to only £118,736, as against £656,636 in the year ended June, 1929, a year which comprised the exceptional profit made by the sale of the control of the American Potash and Chemical Corporation, and had not seen the inception of the disastrous period of progressive stagnation and depression in practically all markets which set in in the autumn of 1929 and of which the end is not yet in sight. On the other hand, the amount received in dividends shows an increase from £311,559 to £385,000. The total of £400,189 carried to the balance-sheet, as against £493,776 last year, has enabled the New Consolidated Gold Fields to declare a dividend of 7½%, compared with 15% last year.

Taking the accounts of the holding company, the Consolidated Gold Fields of South Africa, the accounts actually before you to-day, there is a balance to credit of profit and loss account of £255,079, from which we recommend a dividend of 7½%, less tax at 3s. 7·85d., leaving a balance to be carried forward to next year of £55,784, compared with £51,928 last year. The cash position of the two companies was £1,458,408 at June 30 of this year, whereas at the same date in 1929 is was £1,808,915, the decrease being mainly accounted for by the excess of purchases over sales. We might have paid a better dividend than that which we recommend you to take, but we consider that it would be an act of folly to adopt any other course than to conserve our resources and hope for better times.

After reviewing the position of the principal gold interests on the Rand, the Chairman proceeded:—In Australia we are largely interested in the Lake View and Star, Limited, and the Wiluna Gold Corporation. As regards the former Dr. Maclaren's anticipations as to the southward extension of the principal ore-body in an unprospected section of the Horshoe Lease have been confirmed to a remarkable extent.

In the case of the Wiluna mine the present programme provides for the treatment of not less than 40,000 tons. Developments down to the 600 ft. level, the deepest point yet reached, show the remarkable consistency in value and width of the East lode, and the West lode is equally encouraging. The mine has, in all probability, a minimum life of 20 years quite apart from the possibilities of the Northern Leases, which seem likely to justify the formation of a new company or companies for their exploitation. A proof of the importance of the enterprise is seen in the fact that the West Australian Government, after careful investigation by its own engineers, has spent not less than £750,000 for the benefit of the mine on improvement of port facilities and in building a railway, opened for traffic on January 15 last. Further, the West Australian Government has guaranteed the issue of £300,000 of 6% Redeemable Debentures secured on the property, an issue which also bears the guarantee of the Federal Government. Whether the latter Government will take steps to revive the whole mining industry and increase employment by granting a bonus on all gold produced in excess of the 1929 production is still uncertain. We naturally hope that it will do so because it would enable millions of tons of low-grade ore in West Australia and other parts to be worked at a profit and so develop the gold resources the increase of which is of essential importance to the Commonwealth in its present difficult situation.

As regards platinum, our chief interest lies in the Waterval property, which, even at a much greater rate of production than the present, should have a life of over 40 years and must ultimately occupy an important place in the general picture, though at the present price of the metal it can make but small profits. Our other large interest was, as you know, in the Anglo-Colombian Development Company, which owing to the restrictions placed during the War on the export of capital was taken over by the South American Gold and Platinum Company, which, since its formation in 1916 to the end of 1929, has produced through its subsidiaries, in addition to 62,000 oz. of gold, no less than 180,000 oz. of platinum metal, of a total value of over $14,500,000, during which period the average price of the refined metal was not less than £18 per oz. It is, therefore, all the more disappointing that after 14 years of prosperous conditions the managers of a company which is still making a profit at the present price, and has, as we are informed, a surplus of assets over liabilities of $2,017,000, including $1,660,000 in cash, continue to refuse to consider the payment of a dividend.

With reference to base metals and silver, a year ago it looked as if we might expect steady and increasing dividends from the Mexican Corporation, but the heavy fall in the price of copper, lead, and zinc has greatly reduced profits. The sulphide ore developments at Fresnillo continue

to be excellent; but the production of silver from oxide ore can produce little or no profit at present prices, and suspension of operations in this part of the mine may follow in a few months' time, though costs have been substantially reduced. At June 30 the known oxide ore reserves contained over 7,500,000 oz. of silver, which at the present price is hardly worth mining.

The fact that silver has fallen to its present level is, it can hardly be doubted, one of the chief contributory causes of the present world-wide depression in trade; for it is impossible to suppose that the fall in price has not gravely affected the purchasing powers of 700,000,000 Indians and Chinese, the value of whose savings has been cut in half in the last few years.

We are told by authorities that the supply of gold is insufficient to meet the world's credit requirements, and that in 10 years' time or less it is probable, if not certain, that the present gold production of £83,000,000 to £85,000,000, of which South Africa accounts for approximately one-half, will have fallen to about £35,000,000, and that in a further five years South African production will not exceed £10,000,000. If this is so, surely it is time that the chief nations of the world should agree to remonetize silver and fix its price, say, at one-fortieth of that of gold, or 2s. an oz. We are told that this is impossible as silver is mostly produced as a by-product of lead and other mines, but this is no answer. No base metal mine will increase its production of zinc, lead, or copper beyond its economic ratio of production merely for the sake of producing more silver at 2s. per oz., and no purely silver-producing mine will reopen. Suppose that after the demands of the arts and industries are satisfied as much as 300,000,000 oz. is annually available: tdat would amount to no more than the equivalent of £30,000,000 in gold, or, say, the equivalent of 2s. per head of the population of England, France, Germany, Italy, and the United States, certainly no more than is, or shortly will be, required to satisfy the credit requirements of the world and in some measure to restore value to the holdings of silver-hoarding nations and increase their waning power of absorbing European and American goods.

To turn to tin, the mere fact that tin led the slump in base metals makes it the more probable that it will be the first to take a steady upward turn. There are signs that a recovery is at hand; of that recovery, when it comes, we are in a position to take full advantage. Our chief holding is in the Anglo-Oriental Mining Corporation, which, through the London Tin Corporation, controls by far the largest combination of tin-producing companies in the Empire, with a normal annual output of tin oxide exceeding 22,000 tons. We have other tin interests which have been chosen with equal care. The existing condition of the tin market is extremely unsatisfactory from the producers' point of view, and, in fact, though it may not generally be recognized, also from that of the consumer, for such a price level as now obtains holds out no security for the future of the industry. But for the formation and exertions of the Tin Producers' Association, the chairman and the most active member of which have, to your great satisfaction, recently joined our board, the industry would by this time have been in a complete state of chaos; but now that the principle of ore conservation has been established with the co-operation of Dutch and Bolivian producers there is little doubt that a return to healthy conditions cannot be far off.

As regards oil: we still retain undiminished our investments in Trinidad Leaseholds, Apex (Trinidad) Oilfields, Limited, Tocuyo Oilfields, and Creole Petroleum Corporation, all of which are suffering in varying degrees from the depressed conditions obtaining in the oil market, but which we have no doubt will ultimately recover and justify the high expectations which have hitherto been entertained as to their prospects. In the case of the Sospiro Company efforts have been directed in the past year rather to proving the existence and value of oil-producing strata in hitherto untested sections of the company's large holding than to the increase of production from proved areas at a time when the price of oil in Rumania is much below what can be expected under normal conditions.

We have still a very important interest in Celanese, both in the United States and in England, and have no reason whatever to question the desirability of our investment.

The American Potash and Chemical Corporation continues its prosperous career. Though, as you are aware, we sold last year the control at a very satisfactory price, we still are greatly interested in its fortunes and still have the management in our hands.

In view of the depression in base metals you may be sure that we lose no opportunity of investigating any gold propositions that may be presented to us. We are glad to be able to report that in the Bulolo property in New Guinea we believe a gold-dredging area has been discovered of exceptional merit. We have, through our American subsidiary, a considerable interest in the company formed to work this deposit.

The only other important new venture on which we have recently embarked is the treatment of Estonian oil shales. A first unit capable of treating 250 tons of shale per diem is now in course of erection in Estonia, which we hope and believe will be in successful operation by next April.

On the whole, and taking into consideration the fact that the year under review saw the Hatry episode and an unprecedented collapse of values in the United States, both of which events contributed to the progressive slump in all markets the end of which no one can foresee, the financial year which terminated at the end of June has been less unsatisfactory than might have been anticipated. This is no occasion for political discussion, but this much may be said without fear of contradiction—that, so long as industry continues to suffer from a burden of taxation which is borne by no other country, and the present uncertainty as to the maintenance of safeguarding duties is allowed to continue, it is difficult not to take a pessimistic view of the immediate prospect. If the former is to be increased, and the latter are to be removed, present depression and depreciation are as nothing compared with what we may see in the near future.

Mr. E. Birkenruth seconded the resolution, which was carried.

JOHANNESBURG CONSOLIDATED INVESTMENT CO., LTD.

(Registered in the Union of South Africa.)

The annual meeting of the Johannesburg Consolidated Investment Co., Ltd., was held in Johannesburg on November 25, Mr. W. S. Webber presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended June 30 last, first referred to the illness of Mr. S. B. Joel. Then, after referring to the results of the year and mentioning that their group held the premier position of profit earners on the Rand for the year, he went on to allude to the various interests of the company. Commenting on the Randfontein Estates Gold Mining Company, he said: During 1929 2,528,000 tons were crushed, resulting in a working profit of £246,705. The results for the current year show a decided and progressive improvement. Excellent progress is being made with sinking the old Randfontein Deep shaft, which is expected to reach its final depth in April next and to be brought into commission in the latter half of the year. This shaft will greatly facilitate the working of the Main Reef Section of the mine. The reefs in the main section have a steep dip, approximately 60° to the east, but recent development indicates that a progressive flattening may be expected in depth, having the effect of adding very considerably to the economic life of the mine. The outlook is better than it has been for years past. The expenditure on debenture redemption and interest is drawing to a close; the final sum of £47,000 is payable in March, 1933. Taking this expenditure and capital charges in connexion with the Randfontein Deep shaft into account, the Chairman stated that, if no unforeseen circumstances arise, the company will re-enter the dividend list next year. The ore reserves at the end of 1929 were estimated at 4,505,000 tons, of an average value of 5·8 dwt., over a stoping width of 41 in.

Copper had not escaped the severe and rapid decline in price of commodities now being experienced, and the price was now the lowest known for many years, being little more than half the value of a year ago. Last year your Chairman reviewed the copper outlook of Northern Rhodesia in detail, and in the light of recent progress his considered opinion that conditions generally would be favourable to cheap production and that no undue difficulties were to be expected in mining and metallurgy and native labour supply has proved correct. The company's consulting engineer visited the copper fields recently, and an up-to-date impression is therefore possible. Rapid progress has been made in actual construction work; native labour supply is satisfactory; surface construction work at N'Kana mine belonging to Bwana M'Kubwa Copper Company, in which this company is particularly interested, is well advanced. Since the railway reached the property in May last progress has been rapid and sufficient underground work is completed to indicate what mining conditions may be anticipated. The particular ore-body being developed is a stratified deposit with strike of 8,000 ft., average width 27 ft., average dip 45°, copper content which averages 4·3%. Development is proceeding rapidly on the 300 ft. and 450 ft. levels, and the 600 ft. level will be started shortly. This development has exposed an ore-body in many places, and the information gained fully confirms the estimates of value and width made from borehole data. In the large scale plant, in spite of geographical position, production and marketing costs will be substantially below average world cost, and in course of time the Rhodesian copper industry will compare favourably with the most favoured low cost producers. The present indications are that one large mine will be in full production well before the end of 1931, and the N'Kana mine will be into its stride within the first few months of 1932. The present low price is a matter of concern to all copper mines, but low cost producers may look forward to the future with every confidence.

It was only to be expected there should be a distinct falling off in the demand for diamonds in consequence of the financial crisis in America, and the real revival in the trade must run concurrently with the passing of the general depression, but I wish to emphasise that the intrinsic position of the diamond trade is exceptionally sound. You will have noticed from the statement recently made by Mr. Fourie, Minister of Mines, that a new interproducers' agreement and new sales agreements are in course of preparation; these will take the place of the existing arrangements which terminate by effluxion of time at the end of the year. It is important to remember that the Minister stated that the Union Government, although not becoming a party to the agreements, intends to limit its own sales of diamonds proportionally to the sales of the companies named, namely, De Beers Consolidated Mines, New Jagersfontein Mining and Exploration Company, Premier (Transvaal) Diamond Mining Company, and Consolidated Diamond Mines of South-West Africa, and further, that when selling diamonds to South African cutters to charge prices which work out on a parity with London prices and assortment so as to avoid the possibility of unfair competition, and further, that the Union Government's sales other than to South African cutters will be made only to the Syndicate. In authorising the conclusion of the new agreements the Minister of Mines gave his approval to their being ceded to the Diamond Corporation at a later date. In the first instance the purpose of the Diamond Corporation was confined to the purchase of outside diamonds, but it is now proposed to increase its capital and extend its operations to the purchase and sale of all diamonds, both producers and outside. The members of the Corporation are De Beers Consolidated Mines, New Jagersfontein Mining and Exploration Company, Consolidated Diamond Mines of South-West Africa, and the present members of the Diamond Syndicate. The import of the announcement by the Government, above referred to, is that the control of diamonds has once again been established, and that the Government is co-operating with the producers in maintaining and stabilising the diamond trade.

The motion was passed unanimously.

LUIPAARD'S VLEI ESTATE AND GOLD MINING CO., LTD.

Directors: E. Turk (Chairman), W. Dereham, S. Fortescue, F. H. Hamilton, E. T. McCarthy. *General Manager:* N. C. Krone. *Secretary:* E. H. Fenson. *Office:* Friars House, 39–41, New Broad Street, London, E.C. 2. *Formed* 1896. *Capital issued:* £224,279 16s. in 2s. shares.
Business: Operates a gold mine on the Far West Rand.

The ordinary general meeting of the Luipaard's Vlei Estate and Gold Mining Company, Ltd., was held on December 9, 1930, at Winchester House, Old Broad Street, E.C., Mr. E. Turk (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended June 30 last, said: The accounts show a profit of £37,033, making the total credit on profit and loss account £83,533. Our profits have been used for the enlargement of our treatment plant and the reorganization of our underground operations. We have therefore transferred the sum of £75,000 to a general reserve account. We carry forward the sum of £8,533. At the last general meeting I said that the beginning of 1930 would be a landmark in the history of the company. This prediction has been fulfilled, and I may say at once that, provided nothing untoward happens, we can to-day anticipate with confidence that the work that has been done within the last twelve months will bear fruit in 1931 in increasing outputs and profits.

The important change in the company's affairs, to which I referred last year, was the completion of the new haulage on the sixteenth level of the south vertical shaft and the enlargement of the treatment plant. The success of the new system is illustrated by the fact that during the period September-October-November of this year we have been able to send to the mill nearly 93,000 tons of ore, compared with 68,600 tons during the corresponding three months of last year. Working costs have been brought down in two years by more than 2s. per ton, and we hope that a further reduction will be possible when we crush regularly still larger quantities of ore. Our present monthly tonnage is about 32,000 tons. Our enlarged plant is capable of treating 35,000 tons per month and this monthly tonnage should pass through the mill early in the new year. Development in the mine has been advanced energetically and with satisfactory results. With larger tonnages going to the mill, the developments of fresh ore reserves have to keep pace. It is satisfactory to note that our ore reserves calculation at June 30 shows, despite the larger tonnage milled this year, an increase in fully developed ore of about 150,000 tons compared with twelve months ago, bringing the total to well over 1,000,000 tons. We expect to see a further increase as soon as the central section is further opened up. The Board have created £150,000 7% notes to liquidate indebtedness and to provide the money for the completion of the present capital programme.

Mr. W. Dereham seconded the resolution, which was carried unanimously.

JANTAR NIGERIA CO., LTD.

Directors: A. R. Canning, E. W. Janson, Percy Tarbutt. *Secretary:* William Pocock. *Office:* 18, St. Swithin's Lane, London, E.C. 4. *Formed* 1912. *Capital:* £135,000 in 3s. shares.
Business: Operates alluvial tin properties in Northern Nigeria.

The eighteenth ordinary general meeting of the Jantar Nigeria Co., Ltd., was held on December 9, 1930, at 18, St. Swithin's Lane, E.C., Mr. Percy Tarbutt presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended September 30 last, said that the profit and loss account showed that the balance brought forward from last year was £14,661, from which had to be deducted, after allowing £2,793 for depreciation, the loss for the year under review of £641, leaving a balance to be carried forward of £14,019. In the balance-sheet the item of stock of tin showed the considerable reduction of £8,051. Last year they had carried a stock of 111 tons, which had been valued with tin at £178 per ton, whereas in the accounts under review the stock was 60 tons valued with tin at £107 per ton. If they took the stock of tin and cash in hand at the date of the last balance-sheet, which together amounted to £22,486, and compared that figure with the stock of tin, Conversion loan, and cash shown in the balance-sheet under review, amounting to £18,102, there was a reduction in their liquid resources of £4,384, which was entirely brought about through the fall in the price of the metal.

They had adhered to the scheme for the restriction of output put forward by the Tin Producers' Association, but in spite of the efforts of that Assocation the price had persistently fallen, being at one time as low as £109 and at the present time only £113 per ton. From October, 1929, to March, 1930, during which time the price of tin had fluctuated between £198 and £165, falling all the time, they had been working at full capacity on all their areas. As, however, the total cost on their lower grade area at Kuru 1 came out at more than could be realized, they had issued instructions to close down the plant there and confine their attentions to plant work at Jantar, where their grade of concentrate was higher, with a consequent lower working cost. They had worked there with their plant for a further three months to June, the price of tin falling during that time from £165 to £135 per ton, when the Tin Producers' Association had decided on further drastic restriction of output. As the directors had found they could obtain their quota cheaper by tribute, they had decided to close down the plant work at Jantar. For the last three months of their fiscal year their tin-winning operations had been confined to tributors only, and, until there was a considerable rise in the price of the metal he could see no prospect of restarting with their plants. Every economy was being effected, and their operations would be confined to tin-winning by native tributors. That would ensure that their property and plants would be efficiently cared for and their reserves of tin would not be unduly depleted.

The report was adopted.

LYDENBURG PLATINUM AREAS, LTD.

Directors : J. A. Agnew (*Chairman*), Lord Brabourne, P. C. Baerveldt, D. Christopherson, F. W. Knacke, Sir Frederick Mills, W. Pott. *Secretary :* James W. Clark. *Office :* 49, Moorgate, London, E.C. 2. *Formed* 1925. *Capital issued :* £292,000 in 4s. shares.

Business : Operates lode-platinum deposits in the Transvaal.

The fifth ordinary general meeting of the Lydenburg Platinum Areas, Ltd., was held on December 9, 1930, at River Plate House, Finsbury Circus, E.C., Mr. J. A. Agnew (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year to June 30 last, said : There is a net balance of £19,122 for the year as the result of operations at the property, compared with £55,616 for the preceding year. While increased development footage accounts for a portion of this falling off and working costs have also increased slightly owing to deeper working, it is to the great reduction in the average price received for platinum throughout the year that the major portion of the difference is due. There were actually produced during the period covered by these accounts 8,743 fine oz. of platinum metals, compared with 8,436 fine oz. in the previous year ; the average price realized, however, was £9 2s. 6d. per oz. for the year just ended, compared with £13 2s. 9d. for the period ended June 30, 1929. In addition to the reduction in profit thus shown, we sustained a further substantial loss on the concentrates which had been accumulating since the commencement of operations, including those from Dwarsriver, and which last year we valued on a basis of £12 per oz. of platinum. This figure was then regarded as conservative, but by the time it became possible to treat this material the price of the metal had fallen very heavily, with the result that we have had to write off a loss of over £8,000.

The balance at credit of profit and loss account at end of June, 1929, was £37,710, from which the dividend for last year, absorbing £14,600, was paid in December last, thus leaving £23,110 as the effective carry-forward. Adding to this the balance at June, 1930, we have £42,232 to be dealt with. General expenses in London and South Africa absorb £10,043, an admittedly high figure but one on which it is difficult to effect any material reduction. The administrative staff, though kept to a minimum consistent with safety, is capable of handling operations on a scale many times that now dealt with, and thus is shown a cost which scarcely reflects the work of the management in a proper light. The interim dividend and the loss on concentrates absorb respectively £14,600 and £8,023, and leave £9,087 to be carried to the balance-sheet.

The total recovery of platinum metals from the ore was 88·7%, or 2·1% better than that of the preceding year, a highly creditable result when it is considered that it was obtained on ore slightly lower in value. Another satisfactory feature is the increased percentage of metallics recovered as compared with the metal contained in the concentrate.

On the Mooihoek section the main shaft was sunk 196 ft. to a total depth of 672 ft. and the ore-pipe fully developed down to and at the 650-ft. level. The payable area at the latter level shows a falling off and a decrease in value. Whether this may be regarded as temporary it is as yet impossible to indicate.

At Driekop the position at the lowest horizon developed on that pipe is the reverse of that disclosed at Mooihoek, the payable area showing a tendency to increase, while the value of the ore is slightly higher than that in the level above. The main shaft was sunk 59 ft. to a total of 440 ft.

The ore-reserve position shows a tonnage slightly less than that of a year ago, but with 0·2 dwt. increased metal content. Of the other properties at Lydenburg there is nothing of interest to report.

The further fall in the price of platinum since the close of the financial year, with little prospect of any improvement in the near future, has created a position of great difficulty for the company. The directors realized that even if the whole of the platinum metals produced could be regularly sold, and this was not to be relied upon, no profit was possible ; to select better grade ore merely to do a little more than meet expenses was a policy that did not commend itself to them, and they therefore decided that they had no option but to close down. The cash resources of the company will thus be conserved and the ore reserves kept intact in the hope that with some material improvement in the price of platinum profitable operations may be resumed. All operations at Maandagshoek plant ceased at the end of November, and after making all the underground workings safe the water will be allowed to rise at Mooihoek and Driekop. The expenditure on account of caretaking and maintenance will be very small, and an effort will be made to maintain the properties in such condition as to facilitate an early resumption of operations if and when circumstances appear to warrant same.

Concerted efforts on the part of the producers of platinum in Canada, South America, Russia and South Africa are being made to increase and broaden the use of the metal in industry and we are not without hope that our efforts may be successful.

Our thanks are again due to the consulting engineers and staff in South Africa for the manner in which they have dealt with the problems confronting them, particularly that of trying to meet the difficulties created through the steady fall in the price of platinum. I feel I ought to refer to the loss sustained by the consulting engineers through the death of Mr. W. E. Turvey, their chief mining engineer. The latter was very largely responsible for directing the early policy of this company.

Sir Frederick Mills, Bart., seconded the resolution, which was carried unanimously.

ROAN ANTELOPE COPPER MINES, LTD.

Directors : A. Chester Beatty (*Chairman*), A. D. Storke, Sir Albert Bennett, C. W. Boise, Carl R. Davis, T. F. Field, J. E. W. Lomas, E. E. Marshall, Major-Gen. H. L. Reed, Dorsey Richardson, W. Selkirk, J. S. Wetzlav. *General Manager in Northern Rhodesia :* D. D. Irwin. *Secretary :* D. C. D'Eath. *Office :* Selection Trust Building, Mason's Avenue, London, E.C. 2. *Formed* 1927. *Capital issued :* £1,198,935 5s. in 5s. shares.

Business : Is developing a copper property in Northern Rhodesia which is approaching the production stage.

The third ordinary general meeting of the Roan Antelope Copper Mines, Ltd., was held on December 8, 1930, at River Plate House, E.C., Mr. A. Chester Beatty (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended June 30 last, stated that in view of the information given to shareholders at the extra-ordinary general meeting held in June last, and in the general manager's annual and quarterly reports issued since, it would only be necessary for him to nake a brief statement bringing this information up to date. After commenting on the accounts, the Chairman stated that the cash position was very satisfactory, there being approximately £1,200,000 in hand to-day. Continuing, he said : The drilling programme carried out during the year has continued to show very satisfactory results ; the completion of borehole No. R.E.12 at the end of September finished this work, and the contract with the Longyear Exploration Company has been terminated. As a result of the drilling campaign the company's engineers in Northern Rhodesia estimated the ore reserves on October 1, 1930, at 108 million short tons, averaging 3·44% copper, of which 95% is in the form of sulphide. The drilling concluded to date does not exhaust the possibilities of the property, for there still remain over 4,000 acres of undrilled ground under which the Roan series of ore-bearing rocks are known to exist. However, in view of the very long life assured by the present ore reserves, it is considered unnecessary to continue drilling operations for the time being.

The Beatty shaft, through which the entire initial mine production will be raised to the surface, has been completed at a depth of 1,000 ft., and the work in connexion with the erection of the permanent headgear, winding engines, and so forth is well advanced. It is estimated that 75,000 ft., or about 15 miles, of drives, rises and cross-cuts are required to prepare the mine for its initial production of two million tons of ore per year. Of this estimated amount 60,030 ft. have already been completed. During the months of September, October and November, the average monthly rate of advance was just over 6,000 ft. This very satisfactory rate of progress ensures that the mine will be ready for production on the scale planned as soon as required by the plant.

I am also pleased to report excellent progress in construction. All workshops are completed and in operation. In the power plant the first 7,000 kw. turbo-generator started operating in August, and the second started in November. The coal plant, which will furnish pulverized fuel for both the power plant and smelter, is also in operation. The erection of the coarse crushing plant, the fine crushing plant, and the concentrator is well advanced, and construction work on the smelter is well under way. In order to give shareholders an idea of the progress of the plant construction we have issued reproductions of six photographs with the directors' report. At the meeting in June last it was stated that production was expected to commence in the autumn of 1931. Since that statement was made, such excellent progress has been made in all departments that there is every probability that operations will commence at an earlier date.

During the year a Central Native Labour Association was formed to serve the rapidly growing needs of the Northern Rhodesian copper mines. Within a very few months after the formation of this association labour shortage practically disappeared and at the present time the compound strength at this company's mine is 4,704 boys. You will appreciate the importance of this figure when I tell you that less than 5,000 boys will be required to operate the mine, mill and smelter at its initial capacity. There has also been a marked improvement in the efficiency of native labour, both on the surface and in the mine. This has been brought about by very careful attention to the training of the native and by the introduction of mechanical equipment of a type suitable for operation by the native worker. In view of the valuable work which has been done in regard to the efficient utilization of native labour, we do not foresee any difficulty in obtaining sufficient native workers for all the needs of the copper industry in Northern Rhodesia.

An anti-malarial campaign was inaugurated during the year and carried out under the supervision of the Ross Institute. Sir William Simpson, Director of Tropical Hygiene, and Sir Malcolm Watson, Principal of Malaria Control of the Ross Institute, both spent a considerable time at the mine in organizing this campaign, and a marked improvement in the general health situation has already resulted. In concluding his report to the directors, Sir Malcolm Watson states : "There is every reason therefore to believe that when the necessary steps to prevent disease have been taken the health on the mine will be as good as that in England, and I anticipate that the application of the knowledge of the prevention of disease which we now possess will result in obtaining these conditions in a very short time." I am sure you would like me to express the appreciation, not only of the directors, but of the shareholders also, of the splendid work carried out by the Ross Institute.

With reference to the copper position, I can scarcely do better than repeat what I said at the meeting of Rhodesian Selection Trust, Ltd., on

October 2 last: "It is certain that over a period of years we may look forward with the greatest confidence to the normal increase in copper consumption. Over 60% of the world's copper is used in the electrical industry, and the whole world to-day is increasing its consumption of electrical energy very rapidly. In the United States, where there has been a huge expansion in the quantity of electricity consumed during the last 20 years, we find that the copper consumed per capita has increased as follows:—In 1912, with a population of 95,000,000, there was a consumption of 8·66 lbs. per person, while in 1928, with a population of 119,000,000, the consumption per person was 16·49 lbs. In Great Britain in 1912, with a population of 45,000,000, the consumption was 6·98 lbs. per person, and in 1928, with a population of 46,000,000, it was 7·89 lbs. per person.

"This condition holds similarly for France and Germany, where there has been a slight increase in this particular period. However, the electrical industry is expanding rapidly in these countries to-day, and with this expansion must come an increase in the consumption of copper.

"For the past 50 years there has been an increase of 6% per annum in the world's copper consumption. If we use this figure, we find that by 1940 the world should be consuming 3,000,000 tons of copper per annum, which would mean that there is only enough copper ore proved in the world to-day to take care of the world's requirements for about twenty years. There may be times in the next ten years when too much copper will be produced, but the average consumption during that period should be sufficient to give a fair average price, and I am sure that we can look forward with great confidence to the future of Northern Rhodesia, and that there is no cause for alarm because of the present low prices."

In concluding my remarks, I should like briefly to summarize the present position of the company. We are now within measurable distance of completion of the first construction and development stage of this great mine, and I feel that the foundation for a long and prosperous life has been truly laid. The highest technical skill available has been brought to bear on every important phase of the work, from the proving of the ore by drill-holes to the working out of the mining method and the designing and arrangement of the concentrating plant and smelter. In this connexion I especially wish to express our indebtedness to the American Metal Company, who have put at our disposal from the start their highly skilled and experienced staff, and also their works at Chrome, New Jersey, where a large amount of invaluable research and experimental work has been carried out. I am confident that when the mine is in full production our original estimate of cost of producing copper will prove to be a conservative one, and our actual costs will compare very favourably with that of any of the large low-cost producers of the world.

Looking farther ahead, when an expansion in our operations becomes warranted—and I think this will be at no very distant date because I believe there will be a great demand for copper in the future—there should be an even further lowering of costs.

It must be difficult for shareholders to realize the vastness of this undertaking, and I would ask you to visualize the enormous work and enterprise involved in the opening of this mine. I want particularly to stress the magnificent work which has been accomplished by the general manager, Mr. D. D. Irwin, and all those concerned in the construction and underground work. The loyalty and energy which have been displayed call for our highest praise, and I am sure that shareholders will desire me to convey to the staff our warmest appreciation for their fine work.

In conclusion, I should like to draw your attention to certain facts. Eighteen months ago there was the greatest spirit of optimism abroad; copper was selling at the very high price of 18 cents, that is about £83 per ton, and all news was good news. Now we are in the midst of a world depression and pessimism is rampant, and all news is bad news. Just as the previous point of view was a wrong one, so also is the present one. There is no doubt about the recovery coming, although it may be slow.

As shareholders in this company, we must not forget that for many reasons, of which the following are the chief, we have every cause for confidence in the present position and prospects of our enterprise:—

First—We are in a strong cash position;

Second—We have one of the great copper mines of the world;

Third—We have enormous ore reserves easily and cheaply worked that present no metallurgical difficulties;

Fourth—We shall produce copper at a cost which, even at the present low prices prevailing, should show good profits.

Fifth—We have one of the finest and most up-to-date plants in the world, and,

Lastly—Our property is situated in a British Colony in a healthy country, with an ample supply of good labour.

From all the facts we have before us I think you will agree that without undue optimism we have very sure grounds for looking forward to a prosperous future for our enterprise.

The report and accounts were unanimously adopted, the retiring directors and auditors were re-elected, and the meeting closed with a vote of thanks to the Chairman, directors, and staff.

WANKIE COLLIERY CO., LTD.

Directors: Sir Edmund Davis (*Chairman and Managing Director*), Sir Henry Birchenough, William Rhodes, D. N. Shaw. *General Manager in Rhodesia:* A. R. Thomson. *Secretary:* H. W. Lampard. *Office:* 2, London Wall Buildings, London Wall, E.C. 2. *Formed* 1923. *Capital issued:* £995,568 in 10s. shares.

Business: Operates collieries in Southern Rhodesia.

The seventh ordinary general meeting of the Wankie Colliery Company, Ltd., was held on November 20, 1930, at Abercorn Rooms, Liverpool Street, Hotel, E.C., Sir Edmund Davis (Chairman and Managing Director of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended August 31 last, said: We are pleased to report a satisfactory year's trading. Although coke sales show a slight falling off as compared with the previous year, coal sales have increased by 38,792 tons, the total amounting to 855,088 tons, as compared with 816,296 tons for the previous year and 724,186 tons in 1928.

Buildings at £232,041 show an increase of £22,571, most of which represents work at the new colliery. Machinery and plant, £631,757, represents an increase of £23,584, consisting mainly of additional boiler plant and water softening plant.

Turning to the profit and loss account, the sales of coal, coke and other products amount to £596,001, compared with £590,466 last year, an increase of £5,535. Rent and sundry receipts in Africa, £14,022, are £841 less than last year, and interest and registration fees in London at £1,423 show a reduction of £185.

On the other side of the profit and loss account, cost of production amounts to £329,671, as compared with £388,613 last year, a reduction of £58,942 on a considerably increased output. This result is mainly due to the large capital expenditure we have incurred at both collieries—so large as to have necessitated the borrowing of £150,000 by means of a debenture issue three years ago—and which was necessary in plant improvements to reduce costs and place the collieries in a position to meet increased demands as Northern Rhodesia develops.

Depreciation amounts to £66,001, compared with £63,287 last year. African general expenses, £6,163, show practically no change, and London expenses at £7,202 are £546 higher than last year. Directors' fees and additional remuneration and interest on debentures stand at the same figure as in previous balance-sheets.

The balance of profit carried to the balance-sheet is £189,808, as compared with £129,430 last year.

I would here like to say a few words in connexion with our employees. The community at Wankie consists almost entirely of colliery employees, who are isolated some 7,500 miles from home, nearly 900 miles from the nearest seaport, and over 200 miles from Bulawayo, which is the nearest town. In such circumstances, it is obvious that unless such a community is able to create suitable social amenities deterioration might ensue. In our case I think I can say without hesitation that, on the whole, no concern in South Africa can boast of a more loyal and contented staff, and in this connexion we give unstinted credit to our esteemed general manager, Mr. A. R. Thomson, who is with us to-day, and whose popularity with his co-workers and his human understanding of their needs has been for the past twenty-two years one of our great assets.

At our last ordinary general meeting I stated that with the two collieries opened out and producing we were in a position to meet any likely demands for fuel we might be faced with both in Northern and Southern Rhodesia, and to make this position absolutely safe we have incurred very heavy capital expenditure during the year under review, and we have found ourselves, for the purpose of placing the colliery in a safe production position and to assure our customers of their supplies, obliged to incur further capital expenditure for the duplication of a very large portion of our power plant. The result of all this capital expenditure has meant a considerable reduction in our working costs.

It will interest you to know that the Rhodesian Railways are also dealing with the positions which will arise at no distant date through the continued growth in our northward-bound coal and coke traffic, and the fact that when the new copper mines in Northern Rhodesia start operations on a large scale there will be a further considerable increase. The railways have recently been considering what steps they should take to provide for the expeditious handling of this traffic. They have decided to improve this section, and have recently obtained legislative authority for the construction of an entirely new line between Wankie and Livingstone. This new line will be 74¼ miles in length, some 11¼ miles longer than the existing line, but the ruling gradient for traffic going northwards will be 1 in 120, against 1 in 50 on the existing line. This improvement in gradient will enable trains of 1,100 tons to be hauled northwards instead of 440 tons on the present line. In other words, one train on the new line will carry as much traffic as two and a-half trains on the existing route.

The railways will have to expend on this new line, which is being started at once, and which will take about two years to complete, about £500,000.

When presiding at our meeting a year ago, I referred to the demand for coal which is bound to arise in Northern Rhodesia, and I see no reason to vary the estimates I then made, though I anticipate the demand for the Roan Antelope and the Bwana M'Kubwa N'Kana mine will arise at a much earlier date than originally anticipated.

The only other information I wish to give you deals with the debenture debt of the company. The debenture debt carries interest at 6% per annum, and, in these times of cheap money, we are of opinion that it is far too high a rate for such a company as ours to pay. We have, therefore, made an arrangement to pay off that debenture debt, and to obtain the necessary funds at Bank Rate with a minimum of 4%, which we think is a very satisfactory arrangement for this company.

Sir Henry Birchenough seconded the resolution, and after the Chairman had replied to various questions, it was carried unanimously.

CONSOLIDATED AFRICAN SELECTION TRUST, LTD.

Directors : A. Chester Beatty (*Chairman*), C. W. Boise, J. A. Dunn, E. W. Janson, G. R. Nicolaus, L. Oppenheimer, Maj.-Gen. H. L. Reed, G. Russell, W. Selkirk. *Secretary :* Robert D. Peters. *Office :* Selection Trust Building, Mason's Avenue, Coleman Street, London, E.C. 2. *Formed* 1924. *Capital issued :* £249,777 15*s.* in 5*s.* shares.

Business : Diamond mining on the Gold Coast, West Africa.

The sixth annual general meeting of the Consolidated African Selection Trust, Ltd., was held on November 20, 1930, at Winchester House, Old Broad Street, E.C., Mr. W. Selkirk presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended June 30 last, said : Gentlemen, our Chairman, Mr. Chester Beatty, is unable to be present through indisposition. He has asked me to express his regrets to you and to say how sorry he is he cannot be with you to-day. Following our usual practice, I propose, with your approval, to take the directors' report and statement of accounts as read.

From the profit and loss account you will see that the total revenue received was £200,648 3*s.* 7*d.* and that, after payment of debenture interest and the premium on debentures redeemed, writing off expenditure on investigations and providing for London administration and office expenditure, the net profit was £180,400 3s. 2d. Adding to this profit the balance of £106,853 4s. 3d. brought forward from last year, there is an amount available for distribution of £287,253 7s. 5d., out of which have been paid two dividends representing 60% on the capital. These dividends, together with income-tax and the sum of £40,300 credited to debenture redemption account, absorb £196,537 0s. 1d., leaving a balance of £90,716 7s. 4d., which it is proposed to carry forward.

The combined carry-forward of Consolidated African Selection Trust, Ltd., and African Selection Trust, Ltd., of £113,971 is substantially the same as that of last year, notwithstanding that, for the first time, an amount has been debited to appropriation account in respect of debentures redeemed and purchased. In future the debentures redeemed annually will be similarly dealt with. But for this debit the combined accounts would show an increase over last year in the carry-forward. At the bottom of page 5 of the annual report you will find certain information which it is necessary to state in accordance with the Companies Act, 1929. The concluding sentence refers to the assets of the West African Selection Trust, Ltd., which was not mining or trading during the year, and whose property assets have now been cancelled and are lapsed. The auditors, as you will see, have given unqualified certificates regarding African Selection Trust, Ltd., and Anglo African Exploration, Ltd.

As hitherto, our revenue continues to be derived mainly from African Selection Trust, Ltd., and we have continued to annex the accounts of that company as well as those of Anglo African Exploration, Ltd., to this company's report and accounts.

The operations of African Selection Trust, Ltd., continue to give satisfactory results. There was a decrease of about 10% in the average price obtained for our diamonds during the year, but owing to an increase in sales and a decrease in costs the total profit of £231,107 17s. 7d. compares very favourably with that of last year, which amounted to £233,059 12s. 7d. This result is all the more satisfactory in view of the depressed state of the diamond market which obtained during the major portion of the financial year.

The deposits being worked by the various plants have been revalued on the basis of closer development work which has been carried out, and I am pleased to say that this shows a considerable increase in yardage and value per cubic yard over the previous conservative diamond reserve estimates. There still remains a considerable area unprospected in which it is fully expected that further workable deposits will be found.

During the year under review additions and improvements have been made to the various camps, and additional plant has been erected ; the reserves of diamonds have been added to, the recovery has been improved, and working costs lowered. These satisfactory results are due largely to the efficiency and loyal co-operation of the management and staff and native employees.

Our interest in Cape Coast Exploration, Ltd., remains unaltered at 32% of the issued capital. The third annual meeting of that company was held in South Africa on November 18. The net profit on the year's operations was £44,977, and the total unappropriated profits carried forward to the current year amount to £47,884. The issued capital is £505,000, property account amounts to £344,000, and investments £138,000. £102,000 has been spent on plant and buildings.

A modern treatment plant of a capacity of 1,000 loads per day was completed and brought into commission in May last, but owing to the continued restriction in output by the Union Government of South Africa the sale of diamonds was kept to the nominal amount of £6,000 per month. As a result of lengthy negotiations with the Union Government a temporary arrangement has been made, which allows the plant being worked to full capacity, and permits the augmented sale of diamonds during the last quarter of this year. This increase, however, is still far from commensurate with the large reserves of diamonds contained in the properties, and I venture to hope that for the ensuing year a considerably increased quota will be obtained.

I am pleased to be able to state that African Selection Trust has completed arrangements for the renewal of its sales contract with the London Diamond Syndicate. I feel that our sales contract has been a very important factor in the successful outcome of our enterprise, and I am convinced that our interests are best served by the closest co-operation with this central marketing organisation.

Consolidated African Selection Trust, Ltd., has continued its policy of examining areas in Africa and elsewhere, but the investigations during the past year have not resulted in the acquisition of any new properties.

We are meeting to-day in the midst of a world-

wide depression, and the fall in commodity prices has established new low records. I presume it is a matter of common knowledge that the diamond trade has been in a very stagnant condition for some months, and so long as present conditions obtain we must, of course, take a prudent view and maintain our business in a strong financial position. On the other hand, there is no doubt that, in the present low commodity prices and cheap money, we have the necessary conditions for business recovery, which I believe will not now be long delayed. Periods of depression and fluctuation are not unusual in the diamond trade, which by reason of control centring in very strong hands is better off than most, and, with the recovery of the world's trade, which is bound to come, there is no question in my mind of the sale of diamonds being fully restored. I think that when we meet next year the skies will be much clearer, and I feel certain, from a long range point of view, that we can look forward with confidence to the prosperity of our enterprise.

Mr. E. W. Janson seconded the resolution, and it was carried unanimously.

Mr. Chas. W. Boise then proposed the re-election of the retiring directors, Mr. J. A. Dunn, Mr. E. W. Janson, Mr. W. Selkirk and Major-Gen. H. L. Reed, V.C., C.B., C.M.G. This was seconded by Mr. G. R. Nicolaus and unanimously approved. On the proposition of Mr. E. J. Shepherd, seconded by Mr. P. R. Loewi, the auditors, Messrs. Annan Dexter and Co., were re-appointed.

Sir Oscar Warburg said that it had been his privilege for some years to move, on behalf of the shareholders, a hearty vote of thanks to the directors. They were all sorry that Mr. Chester Beatty was unable to be present, but they thanked Mr. Selkirk for taking his place with such dignity and clarity. They were all very satisfied that in the midst of world-wide depression they were proprietors of a company which had been able to maintain its earnings and to present the shareholders with a report showing such a strong financial position and also with such admirable prospects for the future when the storm was over. He, therefore, moved a hearty vote of thanks to the Chairman for presiding and to the directors for their administration of the company's affairs, and he asked the Chairman to convey to Mr. Beatty the hearty wishes of the shareholders for his speedy recovery.

Mr. J. L. Williams seconded the vote, and said that he would like to add their hearty thanks to the local staff in West Africa.

The vote was unanimously accorded, and a brief acknowledgment by the Chairman brought the proceedings to a close.

CONSOLIDATED TIN SMELTERS, LTD.

Directors : Don Simon I. Patino (*President*), R. J. Hose (*Chairman*), Sir P. Cunliffe-Lister (*Vice-Chairman*), Sir Cecil L. Budd, Sir George Penny, Senor A. Patino, E. V. Pearce, R. M. Vargas, J. C. Budd, J. H. C. E. Howeson. *Secretary :* F. C. Bell. *Office :* Princes House, 95, Gresham Street, London, E.C. 2. *Formed* 1929. *Capital issued :* £3,256,801.

Business : Operates tin smelting works in this country and in the F.M.S.

The first ordinary general meeting of Consolidated Tin Smelters, Ltd., was held on November 26 at 93, Gresham Street, E.C., Mr. R. J. Hose (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the period ended September 30 last, said : The accounts cover a period of 15 months from July 1, 1929, from which date the shareholders in our subsidiary companies became entitled to participate in the profits of this company. The acceptance of the scheme by the shareholders of the subsidiary companies has been most satisfactory, shareholders in three of the companies having accepted the exchange of shares in full and those in the remaining company to the extent of over 99% of their holdings. The small number of shares still outstanding and held by non-assenting shareholders is being dealt with under Section 155 of the Companies Act of 1929. The date of closing the books of the subsidiary companies has been adjusted to enable their results to be included in our subsequent annual accounts, which will in future be made up to June 30.

The profit for the period amounts to £229,338, which has been allocated as set out in the directors' report, and the whole of the preliminary expenses, amounting to £40,320, has been written off.

You will be interested to learn that the annual output capacity of the subsidiary companies constituting the combine is of the order of some 100,000 tons of tin, which is the largest tin-smelting capacity under one control in the world. Of course, with ore supplies as they are to-day, our smelteries are unable to work at full capacity, but we are satisfied that the disadvantages arising from this fact have been minimized as a result of the formation of this company, in that costs have been kept at a lower level than otherwise possible.

Tin differs from many of the other commodities essential to modern conditions of life in that world supplies are limited, and it is a matter of universal interest that these resources should not be dissipated by uneconomic production Taking a superficial view, it might be supposed that the interest of smelters would be to see the greatest possible amount of tin produced and sent to them, irrespective of economic conditions. We take a different and, we think, a longer view in regarding the interests of the producer and the smelter as interdependent, and have, therefore, welcomed the efforts which have been made to rationalize production in the industry and to obtain an equilibrium between supply and demand.

The report was adopted.

BRITISH BURMAH PETROLEUM CO., LTD.

Directors : Hon. Lionel Holland (*Chairman*), Sir Harvey Adamson, R. S. Dickie, Major E. Seaborn Marks, Edgar Taylor, H. C. Taylor, R. H. Trench. *London Managers :* John Taylor and Sons. *Secretary :* G. H. Wells. *Office :* 5 and 6, Queen Street Place, London, E.C. 4. *Formed* 1910. *Capital issued :* £1,196,284 8s. in 8s. shares.

Business : Exploitation of wells in the Yenangyaung and Singu oil-fields of Burma.

The twentieth ordinary general meeting of the British Burmah Petroleum Company, Ltd., was held on December 9, 1930, at the Cannon Street Hotel, E.C., the Hon. Lionel Holland (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended July 31 last, said : When we met here last December I felt justified in predicting that the results of the then current year's trading would not be less satisfactory than those that were on that occasion. This forecast would have been fulfilled had it not been for two more recent developments that I did not foresee. Thanks to the effects of economics and process improvements and adaptations at our refinery—and in spite of lower average prices for kerosene and benzine and a still further restricted throughput—our net revenue from the completed sales of products exceeded the sales revenue for the previous year. It was assisted during the earlier months of the financial year by a rise in the selling price of wax. But this advantage failed us before the close of the financial year. The price of wax has fallen in harmony with the depressed values that prevail in all departments of the industry that have recently been accentuated by the effort of the Soviet Government to force their oil products upon the market at uneconomic prices.

There is another factor, which we could neither foresee nor control, that has thrown every previous estimate out of gear. I have spoken before of the increasing taxation that handicaps the oil industry in Burma. There is, of course, the Government royalty on production. There are the Indian income and supertax on the company's profits, which now amount to 3s. 2¾d. in the £, and represented a charge, as you will note in the profit and loss account, of over £15,000 on our revenue last year. There is the Excise duty on benzine, which was increased the year before last. Then the Indian Government imposed an Excise duty of 1 anna a gallon upon indigenous kerosene to meet the extraordinary expenditure necessitated by the war, but this emergency duty on kerosene has never been removed. Already, then, of recent years, so heavy has grown the yearly burden of Indian taxation on the oil business that what we have paid in charges in India has exceeded the divisible profits available for dividends. That was the position when we met a year ago, but the last Budget of the Indian Government has rendered it even more oppressive ; the duty on indigenous kerosene has been raised by 50% to 1 anna 6 pies a gallon. Yet it is significant that the Government at the same time seem to have been ready to sacrifice revenue in another direction, for they simultaneously reduced the duty on imported kerosene by 3 pies a gallon.

It is idle, I suppose, to hope that Governments of to-day should follow the wholesome custom of endeavouring to balance their Budgets by cutting down expenditure, instead of adopting the facile, but harmful, expedient of additional taxation. But it is disquieting that the Finance Minister should single out for attack an industry already heavily taxed, which is everywhere passing through an anxious period of depression. The Indian Government are inviting a repetition of the conditions that prevailed during those months of the rate war, which, if continued over a period, would inevitably spell the ruin of all the oil-producing companies in Burma and India with the exception of the Burmah Oil Company. But the position of the Burmah Oil Company is exceptional. Only 60% of its profits are derived from its production and trade in India.

Our trading profit stands at £215,201, as compared with something over £245,000 in 1929. It is brought up to £243,209 by interest and other items, including a dividend upon our holding of Rangoon Oil Company shares. We are proposing to declare a final dividend of 5d. a share free of income-tax—the same final dividend as last year. The total dividends for the year will then equal 6¼d. a share, free of tax, against 7¼d. for the year 1929, representing a sum of £86,942.

Our revenue from sales of products had to be derived from a still diminishing throughput at our refinery. There has been no interruption in the decline in the production of our Yenangyaung and Singu fields, while the wells that are now being drilled by our allied companies, the Salay Oil Lands and the British Burmah Deep Drilling companies, on concessions to the south of the Singu field, and in oil sands deeper than any that have as yet been exploited at Yenangyaung, have not reached to a depth where results could be anticipated. On the initiative of Mr. L. J. Wilmoth we undertook in the Yenangyaung district a considerably increased drilling programme over that of 1929, and had some success in bringing in a number of shallow wells, especially on the Beme field, which are economical to sink and to control ; but their assistance could not prevent a decline of over 20,000 barrels in the year's crude oil output.

The business is financially and technically in a good position to take advantage and reap the benefit of any improvement in the outlook of any revival in prices and trade, and the Board will continue to make every effort to overcome the chief obstacle to the permanent prosperity and success of our business, the decline in the productiveness of our present fields of supply.

Major E. Seaborn Marks seconded the motion, which was carried unanimously.