The Mining Magazine

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CONTENTS

EDITORIAL

SINCE our last issue both parties to the Anglo-Persian oil dispute have agreed to lay their case before the Council of the League of Nations and the matter stands adjourned until January 23.

ATTENTION may be directed to a letter, appearing elsewhere in this issue and dealing with the testing of air-compressors, from the President of the British Compressed Air Society. The test referred to by Mr. Quertier is reproduced in the mining digest.

PRELIMINARY figures are already available with regard to Canada's mineral production in 1932. The total value is estimated at $182,701,000, as compared with $228,029,000 in 1931. The outstanding feature of the returns is the increased production of gold, which totalled 3,055,168 oz., worth $63,155,925, in 1932, as compared with 2,693,892 oz., worth $55,786,588, in 1931.

AMONG the New Year Honours mining men will note the names of Mr. H. W. Gepp, consultant to the Australian Government and a gold medallist of the Institution, who receives a knighthood; Dr. S. W. Smith, this year's president of the Institution and chief assayer at the Royal Mint, who receives the C.B.E., and Mr. A. V. Elsden, of the Royal Arsenal, Woolwich, who receives the O.B.E.

LAST month reference was made to the scheme for the manufacture of basic Bessemer steel in this country. It is interesting to note in this connexion that celebrations were held in Paris in December, organized by the Société des Ingénieurs Civils de France, in commemoration of the introduction into France of the basic process, widely known on the Continent as the Thomas process, after the name of its principal inventor.

THE primary object of the visit to Malaya of the Permanent Under-Secretary of State for the Colonies, Sir Samuel Wilson, was to study decentralization, a subject which has frequently been mentioned by our Ipoh correspondent. It may be said, perhaps, that the unofficial view that a measure of local control be given the individual States was fairly presented to the representative of H.M. Government and that the visit is bound to have had a beneficial effect.

DEVELOPMENT of the Kakamega goldfield appears likely to present the Kenya Government with a difficult problem, in view of the fact that the discoveries lie within a native reserve. The mineral rights of reserved territory have, doubtless wisely, been retained by the administration, whose task it must be to find fresh land for the natives displaced by mining operations. Monetary compensation seems hardly adequate and it would appear that, in the present depressed state of agriculture, it should be easy enough to re-purchase any land that might be required for re-settling the native.

AFFAIRS in South Africa, consequent upon the Union's departure from the gold standard, appear to be in a state of flux. Rapprochement between the opposition leaders, Mr. Tielman Roos and General Smuts, does not appear complete and the formation of a coalition has not yet been decided upon. Meanwhile it is evident that labour troubles—consequent on the desire of the workers to share in the premium—are in the offing, while it is rumoured at the same time that a heavy premium tax will be imposed by General Hertzog's Government. The gold mines, therefore, may not benefit by the devaluation to the extent that other primary producers are likely to.

ELSEWHERE in this issue is a letter from Mr. Hugh Picard with regard to the appeal made in the MAGAZINE of February last on behalf of the Benevolent Fund of the Institution of Mining and Metallurgy. The success met with is gratifying, in view of the prevailing depression, and speaks well for the generosity of the profession and those associated with it. Whilst at all times ready to help in any direction desired, the publication of the monthly subscription list should not be continued indefinitely. In this issue will be found the Eleventh List and we propose ceasing publication after the appearance of the Twelfth List in our February issue. It does not follow, of course, that either individuals or companies need subsequently button up their pockets.

Non-Ferrous Metals in 1932

Once again no very favourable account can be given for the year that has recently closed, so far as non-ferrous metals are concerned. From every standpoint it was an unsatisfactory one for the copper industry. Production, which was reduced to 26½% of capacity at the beginning of the year, was cut further to 20% in April, but even then the unwieldy stocks stubbornly refused to shrink. Consumption has fallen to little more than one-third of the peak levels established in 1929, but fortunately production costs have been reduced to a remarkable extent. Standard copper to-day is selling at about half the pre-war price and that on a paper basis against gold. Despite the rapid growth of low-cost capacity, producers adhered to their unpopular and uneconomic methods of trying to control prices through Copper Exporters, Inc., which organization came to an inglorious end following the imposition of a duty of 4 cents per pound in the United States in June. It is doubtful whether any but high-cost producers, who should have retired from the race two years ago, will mourn its decease. Further complications to the industry were introduced by the proposed tariff of 2d. per pound on non-Empire electrolytic copper imported into this country and, although so far this duty has not been imposed, it remains an ever-present possibility. The proposed duty, however, carried the proviso that Empire producers must supply consumers here at a price not exceeding the world-price and latterly enthusiasm for its application seems to have waned somewhat. In December there was a conference of producers in New York to discuss the possibility of renewing the output-curtailment plan for 1933 and to arrange a mutually agreeable marketing policy. Empire producers, however, definitely opposed any further attempts to control prices or to limit their daily sales, but the conference actually broke down on the demand of some of the newer low-cost producers—especially in Rhodesia—for more equitable production quotas. The present situation is extraordinarily complicated and the outlook more than usually obscure. At present there is probably enough productive capacity with a cost price of 5 cents per pound or thereabouts to supply twice the current needs of consumers. Despite this, thanks to the misguided efforts of Copper Exporters, Inc., most of the old higher-cost producers are still operating, having been induced to continue production even at a loss, in the vain hope of an early return to higher prices. The effect of the American tariff has been largely to immobilize the enormous stocks in the United States—probably fully 700,000 tons of refined copper—which at present are sufficient to supply about two years' domestic requirements. In Rhodesia, after expending enormous sums on development work, up-to-date and large-scale properties have recently come into operation, which cannot very well refrain from turning out metal. In Canada there is a big productive capacity from mixed metal mines which enables copper to be produced at extremely low prices. France has given a protection of 2% to Belgian copper, whilst exchange difficulties in Germany hamper business in that direction. The possibility of a tariff here on non-Empire copper complicates the position further. The only possible solution appears to be for higher-cost properties to close down, but this takes time, and, whilst consumption remains as small as it is at present, the outlook for prices is anything but favourable.

The continued falling-off in the consumption of tin during 1932 necessitated further drastic curtailment of output in countries comprised in the Government-controlled production restriction plan. Despite this the reduction in the large surplus supplies has been disappointingly meagre. Prices in the latter part of the year made a more favourable showing than in the earlier months, due largely to the fact that the International Tin Pool is holding 21,000 tons off the market and that another pool has utilized large financial resources to sustain prices. At the higher level now prevailing new properties are coming into operation, notably in the Belgian Congo. As to lead, stocks during the past year have increased throughout the world and, with many producers still unwilling to curtail output on any substantial scale, together with a considerable output now coming from Mount Isa, production at present remains rather in excess of consumption. Practically all branches of the consuming trades have shown a falling away during 1932, the last country to be affected materially being the United Kingdom. but even now this country is better situated than most others. Everything seems to hinge on a general trade revival, failing which the immediate outlook for lead seems unsatisfactory. The efforts of the International Zinc Cartel to reduce stocks by curtailing output have been more successful during the past year than those of any similar body. Production was further curtailed to 45% of the agreed basis in August and stocks fell by some 35,000 tons during the first 11 months of the year. Consumption continued unsatisfactory, owing largely to the depression in the galvanizing industry. Nevertheless, when the time came to consider the renewal of the cartel for 1933 and the continuation of production quotas at 45%, some members pressed strongly for permission to produce on a larger scale and the situation at the moment is rather precarious. Until the cartel settles its affairs definitely one way or the other the outlook must remain obscure.

The Institution Meeting

The attendance at the December meeting of the Institution was somewhat affected—as usual—by seasonal calls on members' time, but there was, nevertheless, a good number present to hear the presentation of two interesting papers. The first of these—" Reduction Works Practice at Morro Velho, Brazil "—was by Messrs. J. H. French and Harold Jones and dealt with the activities of the St. John del Rey Mining Company, while the second—" Notes on a Tunnel driven at Stan Trg Mine, Yugoslavia," by Mr. D. J. Rogers—described development at the property of Trepca Mines, Ltd. The programme was, therefore, attractive to both mill-men and miners, to both precious-metal and base-metal interests, and those who went to the trouble of attending must assuredly have felt that their evening was by no means wasted.

In introducing the paper on St. John del Rey the president—Dr. Sydney Smith—reminded his hearers that information on procedure at this mine had always been difficult to obtain, a fact which lent it additional interest. The authors—who were unavoidably absent—refer in this paper to the complexity of the ore mined at Morro Velho and the associated properties, which they describe as a finely-crystalline mixture of quartz, carbonates, pyrrhotite, pyrite, and arsenopyrite, together with small amounts of chalcopyrite and chlorite and traces of other minerals. The gold content of the ore averages about 12 dwt. per long ton and the process of extraction—a system of gravity concentration, followed by cyanidation, with roasting of some of the concentrates—is rendered especially interesting to metallurgists, as those in charge feel that they have successfully conquered what they consider to be the " bogey " of the cyanidation process—pyrrhotite. The authors state that this sulphide cannot be ignored to the extent that it has been in the past owing to its occurrence in new goldfields and they point out that its potent effects may require radical departure from standard milling practice if commercial extractions of gold and silver are to be made. The complete flow-sheet attached to the paper fully illustrates the processes described, but, as the authors point out, it is chiefly in the cyanidation practice that the method of treatment stands apart from general procedure, the cyanide solutions becoming so foul that they cannot be returned to circulation and, in consequence, volumes have to be kept low and cyanidation in thick pulp employed. Discussion of the paper was initiated by Mr. H. K. Scott, who, in reminiscent vein, recalled the vast amount of good work done by the late Mr. Chalmers. Mr. Harley B. Wright, who followed, summarized the metallurgical work described and added his quota to the praise generally accorded to the paper. Other speakers included Mr. A. J. Bensusan, who dealt with his Brazilian days ; Mr. E. T. McCarthy, who referred to native practice with similar ores in Korea, and Messrs. W. H. Merrett, F. Yeates, and Mr. W. H. Goodchild. Not all the speakers could agree that pyrrhotite was necessarily such a potent cyanicide as the authors would suggest, but there was scarcely a reference to the possibility of salving cyanide, although it would seem that the installation of some process of cyanide regeneration at St. John del Rey might result in important savings.

From Brazil to Yugoslavia—from the new world to the old—is a far cry, as far as from ore treatment to tunnelling, yet the second paper, dealing with the driving of a deep adit at the Stan Trg mine of Trepca Mines, Ltd., was followed with as close attention as the first had been. This is the second paper that the Institution has had on tunnelling in recent months and readers will no doubt remember the first, by Messrs. Francis and Allan, on work at Halkyn, referred to in the MAGAZINE for February last. At that time it was recalled that tunnelling records had been achieved at various times in both the Halkyn and Stan Trg projects—as well as in the Haweswater tunnel of the Manchester Corporation—and, in consequence, all these projects have been somewhat in the public eye. The driving of the Stan Trg tunnel, as Mr. Rogers recalls, had a dual purpose, being intended to open up the Trepca ore-bodies at a deeper horizon and to drain a large tract of limestone country. The first part of the tunnel—2,387 metres in length—was driven through schist and required support, the remaining 288 metres required to connect up with the shaft sunk from the 760-metre level being in limestone and ore. For details of the work carried out the reader is referred to the paper itself, appearing in the December *Bulletin* of the Institution, but it might be pointed out here that, whilst at Halkyn the drilling was done by machines mounted on bars, at Stan Trg a drill-carriage was used and that at Halkyn slusher mucking found favour with those in charge, whereas at Stan Trg a Butler shovel was installed. Such details were referred to more than once by those taking part in the discussion, which was most appropriately initiated by Mr. J. C. Allan, while Professor Truscott, who followed, compared details of the tunnelling exploits mentioned by Mr. R. E. Palmer in the course of the discussion of Messrs. Allan and Francis' paper. This brought Mr. Palmer to his feet and his able résumé of the main points arising in such work and of the difficulties of concrete emplacement was much appreciated. Several other members were able in the short time still available to express their views, the discussion being closed by a few well-chosen words from the president, the evening having proved a worthy ending to the old year.

The American Debt

Like the poor, the Debt question seems to be always with us. To what extent this incubus is responsible for the world-wide depression which has prevailed for so long and still shows little sign of departing may be open to doubt, but there would seem to be no two opinions on the point that under the conditions now ruling both creditor and debtor nations are adversely affected. It would seem, therefore, that even from the lowest standpoint—that of self-interest—it is incumbent on the United States to come to some settlement and the sooner the better for all concerned. There are, of course, divergent views as to the nature of this settlement and it has been hinted that some amelioration may be forthcoming in return for granting certain trade advantages. In other words, we are to be asked to run the risk of losing in one direction anything we are likely to gain in another. This is a suggestion, in view of the experiences of the last year or two, which is hardly likely to be seriously considered.

This matter should, however, be viewed from a very different angle than that of self-interest. It has to be borne in mind that the debtor countries were engaged in the War for some considerable time before the United States. Further, the whole of the money borrowed by the various countries—for which this country stood responsible—was expended in the United States on War supplies, greatly to the benefit of their own industries. Those who carry their minds back to the period just prior to the United States joining the Allies in April, 1917—more than two and a half years from the commencement of hostilities—will recall the views then expressed by many prominent Americans to the effect that it was as much their War as that of England and the enthusiasm shown by the large number of Americans who attended the Dedication Service at St. Paul's Cathedral on "The entry of the United States of America into the Great War for Freedom" confirmed this view, although one well-known mining engineer who was present pertinently remarked, when congratulated on the good muster of his friends: "Yes, but it should have been held long ago." How many thousands of lives had been lost prior to the advent of the United States is well known and afterwards the sacrifice of life continued to fall far more heavily on those previously engaged in the conflict. To refer, therefore, to the necessity, in effecting any Debt settlement, of compensation being made to the United States for the "sacrifices" they have undergone can hardly be regarded as commendable. Not only in this country, but in the United States, many on the termination of the War held—and still hold—the view that had all debts to the Allies been forthwith wiped out America would have done no more than an act of justice, for even then she would have paid mainly with dollars, whereas the other countries paid mainly with lives.

REVIEW OF MINING

Introduction.—Metal markets opened in the New Year in a somewhat disheartened atmosphere, owing to uncertainty as to the statistical position, chiefly of tin and copper. In the case of tin the small decline in supplies was disappointing ; it is believed, however, that the stocks held by the principal holders are not so large as is generally imagined. As to copper, the failure of the conference in New York naturally affected the price of the metal, although it must generally be felt that the Rhodesian producers have done more than their share in the direction of assisting the high-cost producers.

Transvaal.—The output of gold on the Rand for December was 931,749 oz. and in outside districts 48,869 oz., making a total of 980,618 oz., as compared with 978,716 oz. in November. Last month's figures bring the total for the year to 11,553,564 oz., which is a record. The number of natives employed in the gold mines at the end of December totalled 221,008, as compared with 219,024 at the end of November, also a record.

The accompanying table gives the dividends declared by the Rand gold mining companies on account of the past half-year. Figures for the preceding three half-years are given for comparison and from these it will be seen that Simmer and Jack and Luipaards Vlei have returned to the list, from which Rose Deep is still absent, whilst increases are shown by Crown Mines, Geduld and East Geduld, New State Areas, Randfontein, Robinson Deep B, and West Rand Consolidated and a decrease by New Modderfontein. With the exception of the Van Ryn payment, all dividends are declared in South African currency at the rate of exchange ruling on January 27.

	1st half, 1931.	2nd half, 1931.	1st half, 1932.	2nd half, 1932.
	s. d.	s. d.	s. d.	s. d.
Brakpan	4 0	4 0	3 0	4 0
Consolidated Main Reef	1 3	1 3	1 3	1 3
Crown	3 6	3 6	3 6	4 3
Durban Roodepoort Deep	0 9	0 9	0 9	0 9
East Geduld	—	—	1 0	1 9
East Rand	—	0 6	0 3	0 3
Geduld	3 3	3 6	3 6	4 0
Geldenhuis Deep	1 0	1 0	1 0	1 0
Government Areas	2 3	2 3	2 3	2 3
Langlaagte Estate	2 0	2 0	2 0	2 0
Luipaards Vlei	—	—	—	0 3
Modderfontein B	1 6	1 6	1 3	1 3
Modderfontein Deep	3 0	3 0	2 9	2 9
Modderfontein East	2 0	2 0	2 0	2 0
New Modderfontein	6 0	5 6	5 3	5 0
New State Areas	2 0	2 0	2 0	2 3
Nourse Mines	0 9	0 9	0 9	0 9
Randfontein	—	0 6	0 9	1 0
Robinson Deep (A 1s.)	1 6	1 6	1 6	1 6
Robinson Deep (B)	4½	0 6	0 6	0 7½
Rose Deep	—	0 6	—	—
Simmer and Jack	—	0 2	—	0 1½
Springs Mines	3 9	4 0	3 9	3 9
Sub Nigel	3 0	3 6	4 0	4 0
Van Ryn	0 6	0 9	1 0*	1 0*
Van Ryn Deep	2 6	2 6	2 0	2 0
West Rand	—	—	0 3	0 4½
West Springs	0 9	0 9	0 9	0 9
Witwatersrand Gold	0 6	0 6	0 3	0 3

* Free of tax.

Shareholders of the Meyer and Charlton Gold Mining Co., Ltd. (in liquidation), have been informed that a first dividend of 15s. (South African currency) will be paid during the present month.

The accounts of the Rand Selection Corporation, Ltd., for the year ended September 30 last show a profit of £150,365, which, added to the sum brought in, gave an available total of £242,893. Of this amount £150,000 has been transferred to a special exchange reserve account, leaving £92,893 to be carried forward. During the year the company successfully tendered to the Government for a lease of the undermining rights of the eastern portion of the farm Daggafontein No. 9.

Cape Province.—A circular to shareholders of the Namaqua Copper Company issued this month states that an opportunity has occurred for investment of the company's cash assets in an established company working a well-known sulphur and copper mine. This company has exhausted its cash resources on development and is in need of further capital. The property in question is stated to have been examined by Mr. Edward Hooper, chairman of the Namaqua company, who will lay the whole matter before an extraordinary meeting convened for January 16.

Southern Rhodesia.—The output of gold from Southern Rhodesia during November was 48,082 oz., as compared with 50,416 oz. for the previous month and 44,516 oz. for November, 1931. Other outputs for November were : Silver, 7,927 oz. ; coal, 35,426 tons ; chrome ore, 197 tons ; asbestos, 2,519 tons ; mica, 1 ton ; scheelite, 3 tons.

Some dislocation in the running of the plant at the Sherwood Starr, owing to a portion of the new plant being brought into action and to an increase in the stibnite content of the ore, was announced in the last issue of the MAGAZINE. It has since been stated that the residue from the roaster was nearly normal, treatment having been slightly altered and the quantity of ore from the antimonial stopes restricted.

Shareholders of Wanderer Consolidated Gold Mines have received a dividend equal to 5%, the first distribution made by the company since its formation in 1928.

Northern Rhodesia.—The Rhodesia Broken Hill company announced early this month that the zinc plant had been brought into operation and was running satisfactorily.

The accounts of the Bwana M'Kubwa Copper Mining Co., Ltd., for the year to June 30 last show a debit balance of £50,880, which was carried forward. The company now holds 550,000 shares in the Rhokana Corporation, valued at £3,388,117.

During 1931 the North Charterland Exploration Co. (1910), Ltd., suffered a loss of £17,308, increasing the debit balance carried forward to £70,259. It is stated that the tributor at the Sasare mine has installed crushing machinery. The company is considering the advisability of throwing open its country to prospectors.

Gold Coast.—The Ashanti Goldfields Corporation has declared a final dividend of 25%, making a total of 75% for the year to September 30 last. In addition, a bonus of 2s. per share is recommended.

The accounts of the Fanti Consolidated Investment Co., Ltd., for 1932 show a profit of £19,440, after allowing for depreciation of investments equal to £61,739 at December 31 last.

Shareholders of Tarkwa Banket West have been informed, in connexion with the reopening of the Obuom mine, that two adits are being driven on the South Section.

A capital reconstruction, with an assessment, has been proposed by the directors of Sefwi Goldfields. A new company—Colonial Mining Trust—is to be formed, having a nominal capital in 5s. shares.

Tanganyika.—At an extraordinary meeting of Bukoba (Tanganyika) Tinfields, held last month, it was decided that the company should go into voluntary liquidation.

Australia.—The report of the Sulphide Corporation for the year ended June 30 last shows a net loss of £55,844, which has been met from reserves, the balance in "Reserve for Contingencies" now amounting to £38,000. Operations were resumed at the Central mine in April last and up to the end of June 31,522 tons of ore was raised, against 73,438 tons in the previous year, the output of the mill totalling 4,918 tons of lead concentrates and 7,461 tons of zinc concentrates. The ore reserves at the Central mine at the close of the year were estimated to be 691,130 tons, as compared with 707,834 tons at the end of the previous year. Operations at Cockle Creek were severely restricted, productive work being closed down during the first nine months of the year on all but the acid plants.

The return of the Boulder Perseverance mine for November last gives some details of the running of the new plant, which treated 6,529 tons of ore during the month, at a cost of 15s. 10d. per ton. The change over took place on November 5 and the early difficulties were stated to have been overcome by the end of the month.

Shareholders of the Wiluna Gold Corporation were informed last month that exhaustive tests upon cyanide residues had been completed and had shown that such material could be profitably treated. A plant for this purpose is being erected and is expected to be in operation by the end of April. In the power plant the first additional Diesel unit is now in operation.

It was announced last month by the Sons of Gwalia company that £28,499 had been repaid to the Western Australian Government on account of the loan and that a further £15,000 would be paid before the end of 1932, thus clearing off the whole of the original loan of £76,132.

The report of the Mount Lyell Mining and Railway Company, Limited, for the year ended September 30 last shows a profit of £43,979. Of the balance of £595,523 standing at the credit of profit and loss on September 30, 1931, £500,000 has been transferred to reserve, which now stands at £1,246,684. A dividend equal to 6d. per share, absorbing £38,750, was paid out of the profits for the year. The output of ore from the mines amounted to 362,591 tons, 69,761 tons more than in the previous year, the copper production being 10,956 tons. In addition 162,858 oz. of silver and 4,769 oz. of gold were recovered. The total ore reserves at the end of the year were estimated to be 4,285,653 tons, averaging 2·74% copper and 0·28 oz. silver and 0·02 oz. gold per ton.

Malaya.—During the year ended July 31 last the Pahang Consolidated treated 84,900 tons of ore, recovering 1,515 tons of black tin, against 2,799 tons from 174,100 tons of ore in the previous year, these figures showing the effect of restriction. The profit for the year amounted to £19,287, which, added to the sum brought in, gave an available total of £58,672. Of this amount £7,000 was required for the payment of preference dividends and £6,098 for depreciation, while £10,000 was transferred to reserve, leaving £35,574 to be carried forward. The company's appeal against the Tin and Tin Ore (Restriction) Enactment, which was dismissed by the Court of Appeal in the F.M.S. in January last, was heard before the Judicial Committee of the Privy Council in November and was again dismissed.

The report of Malayan Tin Dredging, Ltd., for the year to September 30 last shows a profit of £33,336, increasing the sum brought in to £146,759. Of this amount £32,500 has been distributed as dividends, equal to 16¼%, while £211 has been written off property account, leaving £114,048 to be carried forward. Under restriction a total of 1,117 tons of tin concentrates was produced, which realized £87,046, or an average of £77 17s. 11d. per ton, against 1,459 tons sold for an average price of £72 6s. 6d. per ton in the previous year.

The accounts of Southern Malayan Tin Dredging, Ltd., for the year ended June 30 last show a profit of £28,372, which, added to the sum brought in, gave an available total of £47,158. Of this amount £24,643 was distributed as dividends, equal to 7½%, leaving £22,515 to be carried forward. The quantity of tin ore produced was 1,129 tons, which realized an average price of £77 13s. 7d. per ton, as compared with 2,075 tons, selling for £71 12s. 2d. per ton, in the previous year. The reduction of output was due to the incidence of restriction.

During the year to June 30 last Southern Perak Dredging, Ltd., made a profit of £4,586, increasing the sum brought in to £19,160, which was carried forward. The output for the year was 338 tons of tin concentrates, worth £27,472, or £81 5s. 7d. per ton, as against 491 tons, averaging £72 8s. 7d. per ton, in the previous year, restriction being responsible for the decreased output.

The report of Rambutan, Ltd., for the year ended June 30 last shows a loss of £2,022, decreasing the credit balance brought in to £3,840, which was carried forward. The year's output amounted to 67½ tons of concentrates, worth £4,879. Since the close of the year arrangements have been made whereby the company's quota will be produced by Tekka-Taiping, Ltd., on a profit-sharing basis.

Shareholders of Sungei Besi Mines, Ltd., were informed early this month that arrangements had been made for the sale of the company's hydro-electric installation to the F.M.S. Government for £200,000. In addition the company will be entitled to receive 4,000,000 units of electricity per annum free of charge for a period of 20 years. The sum received will enable the company to pay off the money borrowed in respect of its holding in Pelepah Tin Dredging, Ltd., the pontoon for whose dredge was successfully launched last month.

The report of Seremban for the year ended June 30 last shows a loss of £803, reducing the credit balance brought in to £576.

Peru.—It is proposed that the capital of the Anglo-French Ticacampa Silver Mining Co., Ltd., be reduced from £200,000 to £100,000 by cancelling 10s. on each of the issued £1 shares.

Spain.—At an extraordinary meeting of San Finx Tin Mines, held last month, a scheme for the reconstruction of the company was approved. A new company is to be formed under the title of San Finx Tin Mines (1932), with a capital of £20,000 in 5s. shares. Present shareholders will be entitled to one share in the new company, credited with 1s. paid, for every nine shares held, the debenture holders accepting four fully-paid 5s. shares for each £1 of debenture stock.

Portugal.—At a meeting of Beralt Tin and Wolfram, Ltd., to be held this month, it will be proposed that the capital of the company be increased from £170,000 to £250,000 by the creation of 320,000 new 5s. shares. It is stated that no issue of shares is contemplated at present.

Apex (Trinidad) Oilfields. — The accounts of Apex (Trinidad) Oilfields, Ltd., for the year to September 30 last show oil profits amounting to £332,457, the final figure, after allowing for amortization and head office expenditure, being £213,443. After adding the amount brought in, there was a total sum of £313,558 available, of which £40,000 was placed to general reserve, £40,528 to Income Tax reserve, and £125,000 distributed as dividends, equal to 25%. After making other allowances a sum of £101,780 was carried forward. Production of oil during the year under review totalled 542,624 tons, as compared with 522,194 tons in the previous year, while the enlarged casing-head gasolene plant produced 1,308,389 Imperial gallons, equal to approximately 3,950 tons.

THE RECOVERY OF ALLUVIAL DIAMONDS

By KENNETH McLEOD, A.R.S.M., Assoc.M.I.Min.E.

The author describes pan plants and mechanical trommel plants for the washing and concentration of alluvial diamonds operating in Gold Coast Colony and compares the two types.

INTRODUCTION.—The method of working alluvial diamond areas in the Gold Coast Colony by pan plants has already been described in these pages,[1] but the writer has found no reference in technical literature to the mechanical trommel plants that operate in the same field. The object of the present article, therefore, is to describe the mechanical trommel plant and compare it with the pan plant. The two types of plant are examined in detail with the object of disclosing the province of each. The types of plant described are common in West Africa and in the Belgian Congo. Fundamentally similar, but with variation in design, they form a class of plant that is widely used for the washing and concentration of diamond-bearing gravels.

FIG. 1.—DETAILS OF A PAN PLANT.

PAN PLANTS.—For concentration in a pan plant (Fig. 1) the gravel is elevated by a belt conveyor and discharged into a feed hopper, from which, with a strong jet of water, it is washed into the main trommel. Two-thirds of the trommel is blind, the remaining third is of $\frac{5}{8}$ in. screen, which accepts the undersize for concentration and rejects the oversize partly for further disintegration and partly as barren waste in the form of clean stones. A series of baffle plates in this blind length, together with the pounding action of large stones as they are carried round the trommel and fall on the mass (in much the same way as matter is crushed in a ball-mill), help in the partial disintegration of the clayey gravel. A pipe inside the trommel impinges water in a series of powerful jets to assist in the breaking down of the consolidated material as it is buffeted, pounded, and thrown to and fro in its disordered passage through the trommel.

The undersize from the screen is received in an apron for delivery to the pans. The plus $\frac{5}{8}$ in. material that is discharged consists of lumps of clay that have not been sufficiently reduced in size and countless stones from $\frac{5}{8}$ in. to 4 in. or 5 in. diam. A copious and strong water service over this screened area helps to clean the stones, etc., prior to their discharge and to provide the water for the pans.

The oversize is received in an apron, from which it gravitates down a steeply inclined steel-lined chute for delivery to the washer, together with the water supply from a 2 in. pipe. The washer is a hollow steel cylinder, mounted horizontally on rollers and kept in its slightly inclined position by suitable thrust-bearings. A series of internal baffles, similar to those in the main trommel, encourage further breaking down of the material and are assisted by the continual pounding of the large stones as they seek their discharge. For this reason it is advisable to allow moderately large stones to pass into the plant and not to restrict their entrance by an unduly narrow mouth to the elevator hopper or to remove them by hand from the conveyor belt.

It is important that the washer be adequately loaded and supplied with sufficient water to ensure as clean a discharge as possible. The discharge end of the washer is equipped with a $\frac{5}{8}$ in. screen of a

[1] THE MINING MAGAZINE, Nov., 1929, and June, 1931.

for the payment of preference dividends and £6,098 for depreciation, while £10,000 was transferred to reserve, leaving £35,574 to be carried forward. The company's appeal against the Tin and Tin Ore (Restriction) Enactment, which was dismissed by the Court of Appeal in the F.M.S. in January last, was heard before the Judicial Committee of the Privy Council in November and was again dismissed.

The report of Malayan Tin Dredging, Ltd., for the year to September 30 last shows a profit of £33,336, increasing the sum brought in to £146,759. Of this amount £32,500 has been distributed as dividends, equal to 16¼%, while £211 has been written off property account, leaving £114,048 to be carried forward. Under restriction a total of 1,117 tons of tin concentrates was produced, which realized £87,046, or an average of £77 17s. 11d. per ton, against 1,459 tons sold for an average price of £72 6s. 6d. per ton in the previous year.

The accounts of Southern Malayan Tin Dredging, Ltd., for the year ended June 30 last show a profit of £28,372, which, added to the sum brought in, gave an available total of £47,158. Of this amount £24,643 was distributed as dividends, equal to 7½%, leaving £22,515 to be carried forward. The quantity of tin ore produced was 1,129 tons, which realized an average price of £77 13s. 7d. per ton, as compared with 2,075 tons, selling for £71 12s. 2d. per ton, in the previous year. The reduction of output was due to the incidence of restriction.

During the year to June 30 last Southern Perak Dredging, Ltd., made a profit of £4,586, increasing the sum brought in to £19,160, which was carried forward. The output for the year was 338 tons of tin concentrates, worth £27,472, or £81 5s. 7d. per ton, as against 491 tons, averaging £72 8s. 7d. per ton, in the previous year, restriction being responsible for the decreased output.

The report of Rambutan, Ltd., for the year ended June 30 last shows a loss of £2,022, decreasing the credit balance brought in to £3,840, which was carried forward. The year's output amounted to 67½ tons of concentrates, worth £4,879. Since the close of the year arrangements have been made whereby the company's quota will be produced by Tekka-Taiping, Ltd., on a profit-sharing basis.

Shareholders of Sungei Besi Mines, Ltd., were informed early this month that arrangements had been made for the sale of the company's hydro-electric installation to the F.M.S. Government for £200,000. In addition the company will be entitled to receive 4,000,000 units of electricity per annum free of charge for a period of 20 years. The sum received will enable the company to pay off the money borrowed in respect of its holding in Pelepah Tin Dredging, Ltd., the pontoon for whose dredge was successfully launched last month.

The report of Seremban for the year ended June 30 last shows a loss of £803, reducing the credit balance brought in to £576.

Peru.—It is proposed that the capital of the Anglo-French Ticacampa Silver Mining Co., Ltd., be reduced from £200,000 to £100,000 by cancelling 10s. on each of the issued £1 shares.

Spain.—At an extraordinary meeting of San Finx Tin Mines, held last month, a scheme for the reconstruction of the company was approved. A new company is to be formed under the title of San Finx Tin Mines (1932), with a capital of £20,000 in 5s. shares. Present shareholders will be entitled to one share in the new company, credited with 1s. paid, for every nine shares held, the debenture holders accepting four fully-paid 5s. shares for each £1 of debenture stock.

Portugal.—At a meeting of Beralt Tin and Wolfram, Ltd., to be held this month, it will be proposed that the capital of the company be increased from £170,000 to £250,000 by the creation of 320,000 new 5s. shares. It is stated that no issue of shares is contemplated at present.

Apex (Trinidad) Oilfields. — The accounts of Apex (Trinidad) Oilfields, Ltd., for the year to September 30 last show oil profits amounting to £332,457, the final figure, after allowing for amortization and head office expenditure, being £213,443. After adding the amount brought in, there was a total sum of £313,558 available, of which £40,000 was placed to general reserve, £40,528 to Income Tax reserve, and £125,000 distributed as dividends, equal to 25%. After making other allowances a sum of £101,780 was carried forward. Production of oil during the year under review totalled 542,624 tons, as compared with 522,194 tons in the previous year, while the enlarged casing-head gasolene plant produced 1,308,389 Imperial gallons, equal to approximately 3,950 tons.

THE RECOVERY OF ALLUVIAL DIAMONDS

By KENNETH McLEOD, A.R.S.M., Assoc.M.I.Min.E.

The author describes pan plants and mechanical trommel plants for the washing and concentration of alluvial diamonds operating in Gold Coast Colony and compares the two types.

INTRODUCTION.—The method of working alluvial diamond areas in the Gold Coast Colony by pan plants has already been described in these pages,[1] but the writer has found no reference in technical literature to the mechanical trommel plants that operate in the same field. The object of the present article, therefore, is to describe the mechanical trommel plant and compare it with the pan plant. The two types of plant are examined in detail with the object of disclosing the province of each. The types of plant described are common in West Africa and in the Belgian Congo. Fundamentally similar, but with variation in design, they form a class of plant that is widely used for the washing and concentration of diamond-bearing gravels.

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It is important that the washer be adequately loaded and supplied with sufficient water to ensure as clean a discharge as possible. The discharge end of the washer is equipped with a $\frac{5}{8}$ in. screen of a

1 THE MINING MAGAZINE, Nov., 1929, and June, 1931.

Fig. 2.—Hand-Picking Discharge from Second Washer.

smaller diameter than the washer itself, so that a bed of gravel and water can be maintained, over which the discharged material must ride to find an exit. Once more minus $\frac{5}{8}$ in. and plus $\frac{5}{8}$ in. products are formed as undersize and oversize. The undersize is received in a chute and carried sideways to a dewatering box, from which it is transported periodically to the elevator and so to the pans for concentration.

The washer oversize may be clean, in which case it is transported and returned to the cut to level out the worked-out ground, or it may be moderately clean so that the clay balls can be hand-picked (Fig. 2) and set aside for further treatment, or, lastly, the imperfectly-washed oversize may be so excessive that the whole of the discharge requires re-treatment and is dumped for weathering before it can be broken down easily. In some places the ground is so compact and clayey that it is extremely difficult to break the clay balls as they are discharged, but a period of weathering in the open usually renders them so readily amenable to treatment that expensive machinery can be dispensed with in favour of natural methods at no cost.

For efficient work it is only necessary to retain the gravel in the washer for the time *just* required to wash it. The baffles can be so arranged, with a little care, that the ratio between the plates that advance the washer product to those that retard its progress is such that the feed is retained only for the time required to produce as clean an oversize as possible and to break down the gravel sufficiently to allow it to pass the $\frac{5}{8}$ in. screen. Where the ground is difficult to treat two washers may be used in series (cf. Figs. 3 and 4). The $\frac{5}{8}$ in. material that passed through the latter end of the main trommel by way of the $\frac{5}{8}$ in. screen is led to No. 1 pan by an appropriate chute tangential to it, so that the gravel is received at the periphery of the pan.

Concentrating pans vary in size and shape, but those with which the writer has had experience are 10 in. deep and 8 ft. in diameter, with vertical sides. These pans are more common and are to be preferred in the writer's opinion to those with sloping sides. A vertical spindle, resting on a journal bearing and driven by crown wheels from the main shaft, supports eight horizontal arms, braced to each other by angle irons.

Fig. 3.—Pan Plant with One Washer.

Each of these arms carries five triangular tynes or " knives," with the exception of one arm that has four triangular tynes and one outer round tyne nearest the periphery of the pan. There are thus 39 triangular tynes and one round tyne to each pan, or 80 tynes in all for the plant. The spindle that carries these tynes revolves at 13¼ r.p.m. and as the tynes trace out their concentric paths within the pan the thick water and gravel contents are ploughed up and set in motion, in the same way that tea is swirled round a cup when stirred with a spoon. By centrifugal force and the action of the tynes in the stirred up puddle, the diamonds, together with other material of a high specific gravity, migrate to the periphery of the pan and the lighter particles collect in the innermost area round the pan centre, whence, by a weir discharge in one portion of the inner wall, they pass over the " gate " and are delivered tangentially to No. 2 pan as tailing from the first concentration.

It is not generally understood what constitutes a good " puddle " in the pan, nor how to produce and maintain one. For efficient concentration the puddle should be of such a consistency—that is, the ratio between solid to liquid in the pan should be such that the gravel will rise up just behind the round tyne, nearly to the surface of the thickened water. By dipping the hand into the pan as the round tyne cleaves its way through it should be possible to feel the gravel just below the surface and the water should be fairly thick. If the puddle is too thin, as sometimes happens when the ground is free-wash, the gravel banks up at the periphery of the pan and spills. There are two alternatives open to the engineer in charge to check this loss of concentrate. The feed can be slowed down, which reduces the plant capacity, or the puddle may be thickened. The latter is the better course and may quite easily be done by sending a little overburden to the plant along with the gravel. This has an immediate quietening effect in the pan and restores it to normal activity. Too thick a puddle can easily be remedied by the addition of more water to the pans. The plant should never be run above capacity, as is sometimes done when dealing with easily-treated ground, or an abnormal tailing loss will very often nullify the advantages of a large yardage milled.

On the bottom of each pan at the outer edge there is a small discharge pipe, from which the concentrate can be tapped off at intervals. No. 1 pan concentrate is drawn off and sized, whereas the tailing passes into No. 2 pan for further concentration. No. 2 pan treatment is the concentration of No. 1 pan tailing.

Fig. 4.—Pan Plant with Two Washers in Series.

A further two products are produced in No. 2 pan and the concentrate, as before, is drawn off, but in this case the tailing is rejected as waste, subject to consistent and careful sampling. No. 2 pan tailing should show a loss of only a fraction of a carat per cubic yard. When the loss is greater the cause may often be traced to wrongly set or badly worn tynes. Unless carefully supervised, native fitters are apt to set one or more tynes wrongly and in opposition to the remainder, thereby interfering with the process of concentration. It is imperative that the tynes should be kept to their correct gauge and set with their proper clearances above the pan bottom (¾ in. for triangular tynes and 1 in. for the round tyne) and this is most easily done by laying a ¾ in. lath in the empty pan bottom, allowing the lower ends of the row of tynes to rest thereon and when tightening the socket nuts before withdrawing the lath. The most convenient plan is to have two complete sets of tynes for use alternate weeks and resharpening in the intervals.

The material has now been partially concentrated and the concentrates from the two pans are either delivered by hand in buckets to the sizing trommel or water borne through pipes from the pans. The sizing trommel spindle supports spider arms, which in turn carry the several screens. The sizes used by the writer were 1 mm., 2 mm., 3 mm., 4 mm., and 8 mm. mesh. The undersize from the 1 mm. screen passes by way of a launder into a sump, in which the sand and slime settle out and from which the water is pumped to a tank in the plant for recirculation. The oversize from the final screen is spread over the worked out area; diamonds as large as plus 8 mm. diameter have so far not been found in the Colony.[1]

The sizing trommel receives the pan concentrates into the feed hopper, from which they are washed on to the screens by a flow of water from a flexible hose-pipe. The screens are kept from blinding completely by an external pipe, from which powerful jets of water impinge, but this is not sufficient to prevent partial blinding and they have each week to be cleaned with a wire brush. While running the trommel may be lightly tapped with a wire brush or stick to dislodge such angular stones as may have become wedged in the apertures.

The four sized products are taken in head pans from the bins into which they fall on delivery from the sizing trommel and emptied into the jig hoppers. There are usually four jigs of the Harz type, each with two compartments, both of which have 1 mm. screen trays over which the concentration takes place. The depth of bed and speed of jigging are determined by the design of the plant and are not altered. The length of stroke, rate of feed, and water supply are, however, variables to which the plant-engineer should give careful attention. Strokes vary from $\frac{3}{16}$ in. for the smallest size to $\frac{3}{4}$ in. for the minus 8 plus 4 mm. product in the first compartments of each; the strokes in the second compartments are slightly longer—say, $\frac{1}{4}$ in. and $\frac{7}{8}$ in. respectively. Speeds are of the order of about 170 to 240 r.p.m., intermediate sizes requiring speeds between these limits. Small-sized particles demand a quick rate of jigging and a small stroke, large particles a slower speed and an increased stroke. No hard and fast rules for jigging can be laid down, as so much depends on the nature of the concentrates. The success of the jigging can be tested by sampling the tailings and by the number of diamonds that appear in each compartment. If only an occasional diamond is found in the second compartment, it is probable that others have not been lost by "lipping" over the second tail board. Cleavage flakes or "macles" are sometimes seen floating on the water or being discharged as tailing, but as they are light and of little value their loss is of no great importance. They can usually be saved by being pressed down into the bed of concentrate with the finger, where they remain. The concentrates are picked by the native women and girls under the supervision of a native policeman (Fig. 7).

Fig. 5.—Pan Plant, showing Loading Platform and Conveyor.

The waste gravel from the picking shed and the tailings from No. 2 pan and the jigs are spread over the worked out area, which, in a well-organized and carefully-run plant is well levelled, free from puddles, logs, paper,

[1] It is recorded that one diamond of 9 carats, valued at £15, was found, but nothing approaching this size has been discovered since.

FIG. 6.—WORKED-OUT GROUND—CLEAN, LEVEL GROUND LEFT BY SYSTEMATIC REFUSE BURIAL.

broken tools, or other litter left about by disorderly natives. Cleanliness and order make for good work and the general appearance of a plant testifies to the ability of the engineer in charge.

The diversity of practice in cleaning up the jigs prompts the writer to suggest a safe method, which, although employed exclusively on the property with which he was associated, is not standard practice at others. The jigs should be cleaned up at least three times during an eight hour shift and more often when the ground is very rich. If there is a large proportion of laterite in the pan concentrates, as is often the case when the gravel is excavated on the slopes of the valleys, the jigs should be cleaned up when the black particles in the jig are seen to appear on the surface.

With a rich concentrate, in which very little black or dark coloured material is present, it is a matter of judgment when the jigs need attention. The usual procedure is to have set times for cleaning up, but these must of necessity be varied to meet changing conditions.

Each compartment of the jigs is covered by a frame that can be easily removed and in which narrow-gauge expanded metal is inset and the frame locked to the jig. The action of the jig can at all times be seen, yet the concentrate is not accessible to the jig boys, except while cleaning up and in the presence of the European in charge.

By removing the spigot on the bottom of the hutch, the water is allowed to run out until its level in the jig is below the screen. The light tailings are then skimmed off from each compartment and rejected as waste, with the proviso that there should be no dark (heavy) material discarded. The remainder of the concentrate in the second compartment is transferred to the first and the products of both jigged together. After running a few minutes to re-concentrate these two products the jig is stopped and the water run out as before. This time the tailing from the top of the first compartment,

FIG. 7.—DIAMOND PICKERS AND ESCORT.

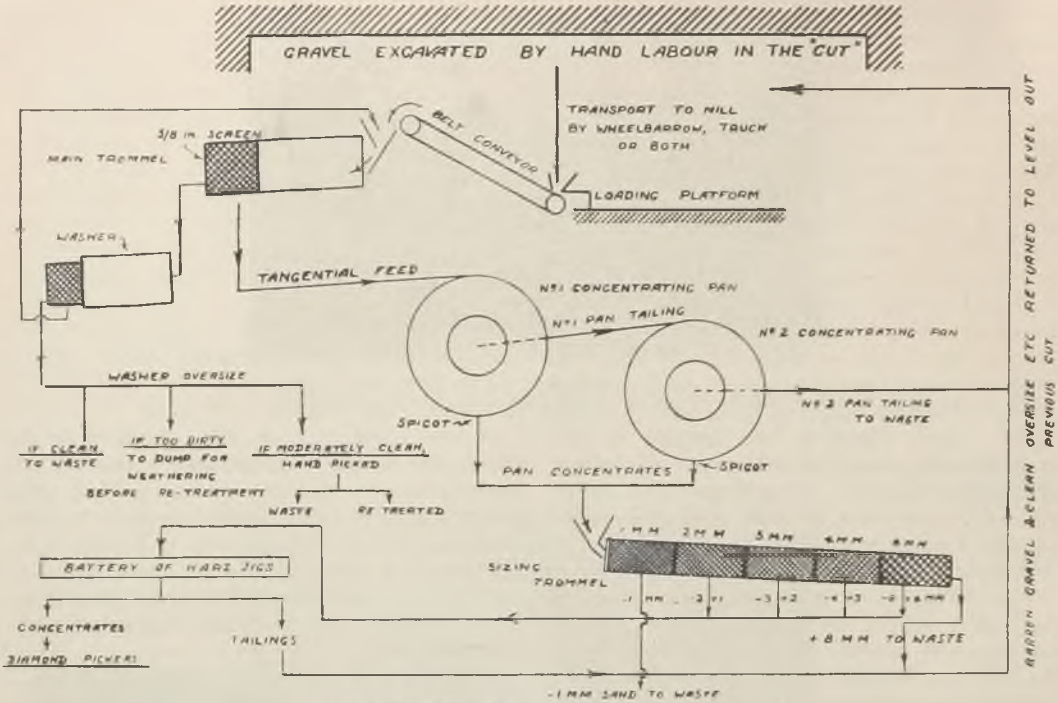


FIG. 8.—FLOW-SHEET OF PAN PLANT.

together with that discharged into the second compartment, is kept for further concentration and returned to the jig hopper, whereas the concentrate is collected and taken to the picking shed. No originality is claimed for this method, but it can be easily seen that the tailings loss is reduced to the minimum.

Each plant may be responsible for its own picking, in which case the concentrates are picked as soon as they are available. If the picking is centralized, the concentrates are dispatched in locked churns and magnetically separated to reduce their bulk before picking. The returns are then sent out to the respective plants on the following day. Picking at the plants is far cheaper than at the central station, where a European is in charge, the cost of whose salary and the expense of magnetic separation, provision of churns, and the daily transport to headquarters nearly doubling the cost.

MECHANICAL TROMMEL PLANTS.—This type of plant does not enjoy the same popularity as the pan plant. It is less expensive both as regards first cost and erection, but the working cost per cubic yard of virgin gravel treated is roughly double that of the pan plant. There is a greater recovery, but a smaller capacity.

Owing to the smaller height to which the gravel has to be elevated for treatment in a mechanical trommel plant a ramp may displace the belt conveyor (Figs. 9 and 10). The gravel is transported in barrows as before, but instead of elevation by the belt-conveyor from the loading-platform almost at ground level it is wheeled in barrows up the ramp to a height of 14 or 15 ft. It may be tipped directly into the puddle-box or on to a platform at the ramp head and shovelled into the puddle-box as required (Fig. 11). The ramp is divided into two parallel gangways, so that a one-way stream of barrows can be maintained.

The puddle-box is an inclined, shallow, steel-lined wooden trough, open at its lower end and served at the head by a transverse water pipe, so that strong jets of water impinge on the gravel as it is tipped or shovelled in. At each side, on platforms provided with guard rails, stand a number of boys. On a particular plant the writer has in mind there were eight puddle-box boys to deal with about 30 cu. yd. of gravel a day. Each boy uses an implement known as a puddle-hoe to break up the clay as it gravitates down the plane. The boy at the head sets the time and the rest work in

FIG. 9.—PAN PLANT: ELEVATION OF GRAVEL BY BELT-CONVEYOR.

unison with him, cutting the clay with a downward stroke, drawing it down the plane, and returning the large lumps to be cut on the succeeding stroke. As the gravel travels down the puddle-box it is broken up by succeeding boys in the line until it leaves the puddle-box and passes over a grizzley with bars 1 in. apart. The oversize is received in a hopper and dumped for re-treatment. Stones and other useless matter are washed clean and thrown into a waste bin below the grizzley and used for levelling out the cut. The undersize passes to the first trommel. from which the oversize is collected in a hopper and dumped for weathering and re-treatment, the undersize passing through the screen and being delivered by an apron to a finer mesh trommel. The minus 8 plus 4 mm. size is the oversize from the second trommel and is immediately recovered, the undersize being treated in the two remaining trommels, each drawing off its oversize for concentration and passing on its undersize. The final product (minus 2 plus 1 mm.) is discharged from the end trommel, the minus 1 mm. product of which passes by a launder to the sump for settlement of slime and sand and re-circulation of the water. The sized products are then jigged as in the pan plant, but in this case jigging is done *through* the screen and a hutch product formed. The hutch products are then collected and placed in the appropriate jigs, together with the gravel of proper size direct from the trommels.

The puddle-box, grizzley, and trommels are in line and the jigs are set beside them. The four trommels are chain-driven from the main shaft and as they are inclined and the shaft horizontal a certain amount of trouble is expected and experienced. Old chains are apt to rust and clog up, lose their flexibility, and ride off the sprockets. The chain links are so made that they can be put together by being held one in each hand in the shape of the letter " V " and one slid into the other. When spread out, as they are when in service, they cannot be removed. It is as well to arrange the number of links in the chain so that they are not a multiple of the number of teeth in the sprocket and so distribute the

FIG. 10.—TROMMEL PLANT: ELEVATION BY RAMP TO MILL HEAD.

FIG. 11.—UNLOADING GRAVEL INTO PUDDLE-BOX.

wear evenly. A rope or rubber belt drive would give less trouble and a better drive, but this was not tried out owing to the design of the trommels for chain drives and the lack of means to make the alteration. The jigs are belt-driven from a counter-shaft, so that the belts are clear of the boys' heads as they attend to the jigs.

In the particular plant described a Pulsometer pump supplied water for the jigs, a centrifugal pump served the puddle-box, and a Merryweather about 200 yd. away provided the water from the trommel sprays.

In larger units there may be two or more puddle-boxes and two lines of trommels, with additional jigs to cope with the greater capacity (Figs. 12 and 14). There is no difference in design or increase in size of any particular part and the larger plant is in effect smaller units combined. The plant of this type on the property where the writer was engaged was served by a conveyor, from which the gravel was divided between the several puddle-boxes. As many as 30 puddle-box boys may be employed on such a double unit plant (Figs. 13 and 14).

Too thorough a washing of the virgin gravel should be avoided. It always pays, from an economical point of view, to send the gravel through the puddle-box rapidly in the first instance and dump the oversize for re-treatment. After weathering for a few days in its semi-washed condition the subsequent re-treatment will be much easier and the yardage appreciably higher. This is the only means known to the writer of increasing the output and thereby reducing the cost per cubic yard treated, without overloading the trommels and jigs or overtaxing the energies of the puddle-box boys.

COMPARISON BETWEEN THE PAN PLANT AND THE MECHANICAL TROMMEL PLANT.—The writer has already pointed out that the mechanical trommel plant is cheaper than the pan plant for first cost and erection. The reason for this is quite evident from the flow sheets. The pan plant is built of H, L, and T section angle iron and must be of sufficient height to allow of a gravity feed from the main trommel through each of the two pans and finally to the sizing trommel.

FIG. 12.—MULTIPLE PUDDLE-BOXES.

Fig. 13.—Single-Unit Trommel Plant.

This necessitates a rigid framework to carry the weight of the loaded pans and trommel and a large capacity water tank situated below the galvanized-iron roof. The structure is an integral part of the plant. The trommel plant, on the other hand, only requires sufficient height for a gravity feed from the grizzley through four 6-ft. trommels—a very different matter as regards cost of materials and erection. The puddle-box, grizzley, and trommels are each mounted on a framework that carries its individual load. The framework can be built of local timber and erected by native carpenters. No heavy machinery like washers need be transported, even if means existed for getting them to the site. The erection of heavy plant is no easy matter under primitive conditions, as those who have experienced it can testify.

All this is unnecessary in a trommel plant. There are no heavy parts to be transported or erected. The main trommel and washer(s) of the pan plant are replaced by a locally-made puddle-box. The sizing trommels, although larger in the mechanical trommel plant and separate, find their counterpart in the pan plant. The jigs, apart from the method of jigging, are identical and the power unit of the portable locomotive design is common to both types of plant. Moreover, in a single unit trommel plant a locally made ramp will suffice, but owing to the greater height of a pan plant an expensive conveyor is necessary. The conveyor belt alone costs nearly £60 and the life is about 18 months, during which time both surfaces will have been used.

A further point in connexion with the trommels is that the trommel plant uses the coarsest mesh screen first and this is more capable of standing up to the passage of the entire product that will eventually be jigged ; only the minus 2 mm. product is received in the 1 mm. mesh trommel. In the pan plant the finest screen comes first, with the attendant frequent replacements every six to eight weeks. If the coarsest material is separated in the first place that part which is left behind has a better opportunity owing to its reduced bulk of being properly sized and washed free of sand and less wear and tear is manifest in the screens.

The real and essential difference between the two plants is that in a trommel plant the whole of the gravel between minus 8 mm. and plus 1 mm. from the cut is sized and jigged, whereas in a pan plant only the pan concentrates less the plus 8 mm. material are jigged. The one is a concentration of washed gravel, the other the concentration of

Fig. 14.—Double Row of Trommels and Multiple Puddle-Boxes.

Fig. 15.—Excavating Overburden under Contract.

gravel already partially concentrated in the pans. No tailings are produced in the trommel plant other than from the jigs. The pan plant produces jig tailings in a similar way, but there is also the additional tailing discharge from No. 2 pan. By elimination of sources of tailing loss in the trommel plant the recovery is better and it is claimed that it is 4–5% greater than that from a pan plant, but this depends, naturally, on the value of the ground. Owing to the simplicity of the trommel plant the maintenance costs are lower and the power required is less.

The working costs calculated on the basis of cubic yards of gravel (in situ) treated are roughly double in the trommel plant. The main reason for this is that the gravel has to be treated three times. The capacity of the plant is based only on the yardage of the virgin gravel washed. A plant may run 24 days on virgin gravel and 30 cu. yd. may be washed daily; the remaining four days, assuming a 28 day month, will be spent on oversize re-treatment. Although 30 cu. yd. have been washed daily, the capacity in terms of virgin gravel treated will only be $\frac{30 \times 24}{28}$ = 25·7 cu. yd. per day and this is the chief cause of the increased cost per cubic yard. A pan plant can wash gravel and concentrate it in a day, but a trommel plant cannot; it

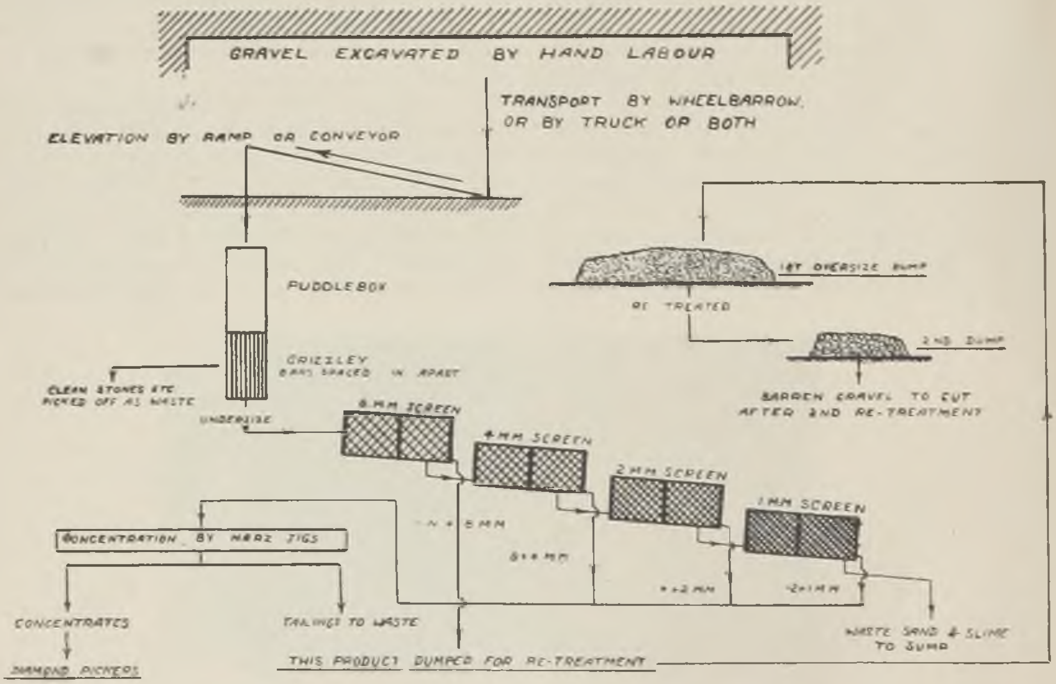


Fig. 16.—Flow-Sheet of Mechanical Trommel Plant.

has, so to speak, to chew the cud before the full recovery is realized. Other reasons for increased costs lie in the puddling and in the transport. In a pan plant the clayey gravel is puddled mechanically, partly in the blind section of the main trommel and partly in the washer. In the trommel plant it is done manually in the puddle-box and this process alone may occupy the time of 30 boys. When a ramp is used the number of boys on transport must be increased to compensate for the slower and more fatiguing climb to mill-head. The three treatments of the gravel is the handicap of the trommel plant, necessitating a larger labour force compared with the pan plant for the same output of virgin gravel. Where labour is plentiful and cheap it is not a vital matter, but in places where labour is scarce or expensive the trommel plant could not replace the pan plant unless the ground was very rich or transport to the site difficult.[1]

[1] Recent work in New Guinea has demonstrated the practicability of transport of plant by air. The choice of plant would then be simplified and preference given to the pan plant.

In the writer's opinion a trommel plant would serve excellently as a pilot plant in isolated country, but the pan plant can treat gravel more quickly, thereby making a quicker return on the capital outlay, particularly in ground that is near the economic limit of payability. Throughout the Gold Coast the limit of payability is generally regarded as round about one carat per cubic yard, but the Government reports of yardage treated and diamond output show that the average value of the gravel washed is well above this figure. The smaller the capital outlay the better the recovery, but the reduced capacity of the mechanical trommel plant must be balanced against the greater cost and larger production with a drop in recovery of the pan plant, not forgetting the transport to the site, in deciding which type of plant should be adopted. Generally speaking, the pan plant will be found more satisfactory and is in practice used to a much greater extent than the trommel plant.

In conclusion, the writer desires to thank his company for permission to publish this description and photographs of their plant.

LIGHTNING.—III

By JOHN F. SHIPLEY, M.I.E.E.

In this, the third of a series of four articles, the author discusses the protection of life and property against lightning.

In the present article it is proposed to discuss the protection of electric power plant against lightning. As this also covers the protection of life and property, the subject is treated as generally as possible.

The position in space of the storm vortex at the top of which the electricity is generated (see Fig. 8) is governed partly by physical and partly by meteorological conditions and a lightning flash is, therefore, likely to follow a fairly regular path owing to the first cause with much irregularity due to the second. The presence of metallic ore-bodies or veins in the ground would not appear to affect this position unless, indeed, it coincided with some important projection from the normal surface of the area. If the ground surface is very flat with only a few projections those projections will concentrate the electric stress and will tend to form parts of the lightning paths. In most places any projections are well distributed, but the climatic variations may cause extreme uncertainty as to the exact incidence of a "stroke." Then again the projection may be invisible to the eye, but very definite to the invisible electric stress. The warm column of air rising from a chimney, or from a tent containing people, or even from a team of oxen, acts in the same way and in flat districts becomes noticeably important as a danger source.

To obviate forming part of the lightning path, therefore, it is necessary to avoid either being a projection on an extensive flat surface or being near one. The obvious thing to do is to get as near the ground as possible and if possible beneath it. This is the keynote for the protection of buildings: Keep them as low as possible, without projections and without rising hot air. The latter cannot easily be avoided—although avoidance is not of great importance overseas, except in cases of steam- or oil-engine stations or smelters—but the tall buildings can be brought low by artificially raising the ground over the building by means of a metallic network properly connected electrically to the earth. For this reason a steel-framed building is reasonably safe, provided its roof, if metallic, is electrically connected to the structure and the structure is earthed by proper means. Mere setting in concrete is insufficient, as good concrete should be an insulator. There must be a good earth capable of carrying a large current. A person inside such a building is protected entirely.

The same principle can be adapted to the cattle fence mentioned in a previous article. If the horizontal wires of the fence are connected and earthed as often as possible by sound metallic connexions a minimum of danger will ensue. They form part of Mother Earth. A telephone line may be regarded as only a tall and open fence, but its one or more telephone wires are needed for the minute electric currents formed by the telephone transmitter, which are very sensitive to any electrical disturbance. The best way to protect them is to put an earth wire above them and to connect this earth wire at frequent intervals to the earth. The instruments will require special protection.

A power-transmission line is, after all, only a large telephone line carrying millions of watts instead of millionths and the safest and surest way of protecting it is to run one or two earth wires along its whole length, with frequent and proper connexion to earth. Telephone lines and power lines, when it comes to lightning protection, can be considered to be one and the same, except insofar as their economic value is concerned. The author has proved that it is possible to run a telephone service in an exposed tropical country—and to use telephone wires that are hung underneath the 33,000-volt power wires (which occasionally fall on them)—and yet maintain without interruption a service that is required most of all during lightning storms.

In such a system special care has to be taken owing to the presence of the live power wires within a few feet, but apart from this the success of such installations is due to the earth wires and connexions and to the efficacy of the lightning protection devices.

Theory suggests and practice has proved that the greater the height of wires above the ground the greater is the voltage should the pole, tower, or line be struck by lightning. On the other hand traffic and safety requirements require telephone or power wires to have certain definite clearances above ground. These are generally fixed either by experience or by definite regulations and therefore tend to be standard. If the problem arises, therefore, of whether it is possible to give an electric supply service without interruption in an overseas country where there may be over 100 days of lightning a year the question of lightning protection becomes economically important. It can be done at a certain expenditure of capital, but complete immunity is not yet possible, owing largely to the extraordinarily short time a lightning flash endures. The author's nearest approach to success is 61 minutes' stoppage in one year's (8,760 hours') running and he hopes to improve upon this as newer, cheaper, and more efficacious appliances become available.

It may now be as well to go more carefully into some of the factors which must be considered when designing the protection of a transmission line against lightning. The arrangement of conductors is one which will be governed very largely by local conditions, such as number of circuits, types of pole used, transmission voltage, and so on, and upon the arrangement of conductors depends the number and position of the earth wires. The number is usually governed by the expense, especially if the earth wire is used as part of a fault-clearing device and has to be of copper, or of even more expensive metal. One earth wire is essential, two give about 50% more protection, but the use of three is questionable. Theoretically an earth wire below the conductors should be as equally serviceable as one above, but practice is in favour of the top position.

The screening effect of the earth wire is most noticeable on voltages from 2,200 to 66,000, for below these voltages the pole heights are low and the lines are short, while above them the high flash-over value of the insulators used approaches more closely to the usual voltage values of surges which reach the power lines. On 110-k.v. lines the number of lightning troubles will be small, on 220-k.v. lines there should be still fewer and perhaps none at all, but on 33-k.v. lines, for instance, there will be numerous troubles if protection is not looked after.

The most important detail of all, and that which is most expensive and most difficult to maintain, is the earth connexion itself and to this much attention has been given. Engineers must get rid of the idea that water is necessarily an electrical conductor.

In the tropics, where thousands of tons of water fall from the atmosphere as a result of condensation, they are presented with distilled water, which is of very high resistance. Water from melting snow and glaciers, especially if these are at a high altitude, is often exceedingly pure and of a very high resistance, measuring infinity when tested with a 500-volt insulation tester. In such places the water must be " let down " by a chemical such as salt or soda before it is used, to reduce the resistance. In a forest country the water will contain various vegetable acids, in other parts the water will be loaded with salts, like magnesium chloride, which will, of course, render it conducting. In any case the water should be examined before it is relied upon to make good earths.

It is useless, or, at least, unwise, to dig a hole and bury an old casting as an earth and it is uneconomical to bury sheets of copper. The best earth and the cheapest is a driven one. The author recommends the use of a 1-in. or 2-in. pipe, old or new, driven 10 or 15 ft. into the soil. Others should be put in near it, say at 6 ft. apart, and the set should be connected together to form one earth made up of six units. It may be difficult to do this, as the site may be confined, but such multiple earths should be aimed at. The resistance of each element should now be measured, as well as the resistance of the group, and recorded and checked at regular intervals. There is a special earth tester on the market, which reads direct in ohms. The readings will probably be high. The area must then be kept damp and salted until the group resistance goes down, aiming at something under 15 ohms. One should not be surprised if erratic readings are recorded as they may be caused by the pipes being too close together, or by other difficulties in measurement, but the resistance to earth should be kept as low as possible. Incidentally the easiest way of calculating the group resistance from that of each element is graphically as in Fig. 12. The base-line distances do not affect the result and the diagram can be built and the resultant obtained in a matter of seconds with a little practice.

If possible the earth wire should be earthed at every tenth pole and at all important turns, especially if they are at a high elevation, or on a ridge, or at an abrupt change of profile. All earths should be numbered and a quarterly record kept of the earth-resistance values. The danger of a high-resistance (i.e., a poor) earth is that when a discharge current is passed to earth the area is immediately raised to a voltage

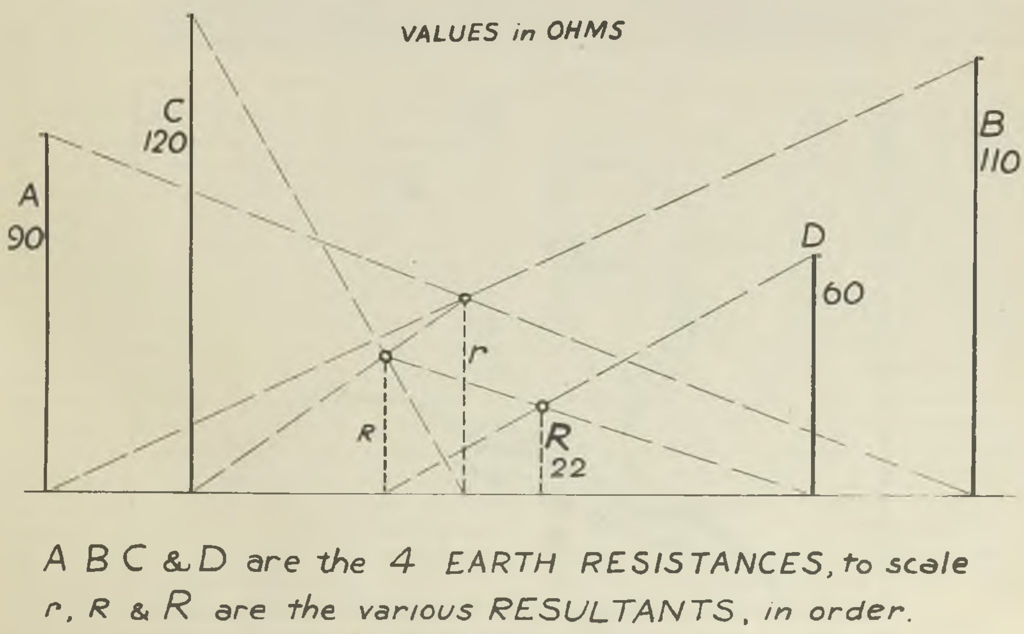


FIG. 12.

equivalent to the current in amperes multiplied by the resistance in ohms. If a person had been standing very close to the earth he would have been similarly raised to a high voltage, with unpleasant consequences. Good electrical men have a great respect for the lightning earth pipe and its connecting lead.

In many countries overseas the geological structure of the terrain is unfavourable to good earth connexions. In these circumstances one must make the best of it. In difficult circumstances an artificial earth can be made by connecting up tanks, rail tracks, posts, towers, substation structures, etc., until the largest possible area is thus connected in and utilized as an earth. Such a counterpoise earth should be again earthed, if possible, at favourable spots, in the usual way to the soil.

TRANSPORT ON AN ANDEAN MINE

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

The author compares the costs of four separate methods of transport used on a mine in the Andes.

At the mines referred to in this article, where the writer was local resident manager, it was found necessary for some months, owing to force of circumstances and local conditions, to employ four different methods of transport for carrying the ore to the refining plants and it is the author's purpose to compare the various methods and the respective transport costs per ton of ore.

Before dealing with transport, however, it may be as well to give a short description of the general topography of the district. The mines are situated in the Andes—forming the boundary between Chile, Bolivia, and Peru—and consist of two deposits located on the peaks and slopes of two mountains, 6,000 metres and 5,700 metres above sea-level respectively (Fig. 1). On deposit 1 mining operations were carried on at point " A " on the flanks of the mountain, at an average height of some 4,800 metres above sea-level and at point " B " some 5,600 metres above sea-level. On deposit 2 mining operations were carried on at point " C," at an altitude of 5,500 metres above sea-level.

The ore mined at these points had to be transported to the refining plants, three in number, two of which—some 7 kilometres apart—were located on the main international railway between Chile and Bolivia, 10 to 15 kilometres east of the deposits, whilst the third refining plant was situated some four kilometres west of the railway, but was connected with refining plant No. 2 by road. The average altitude of the

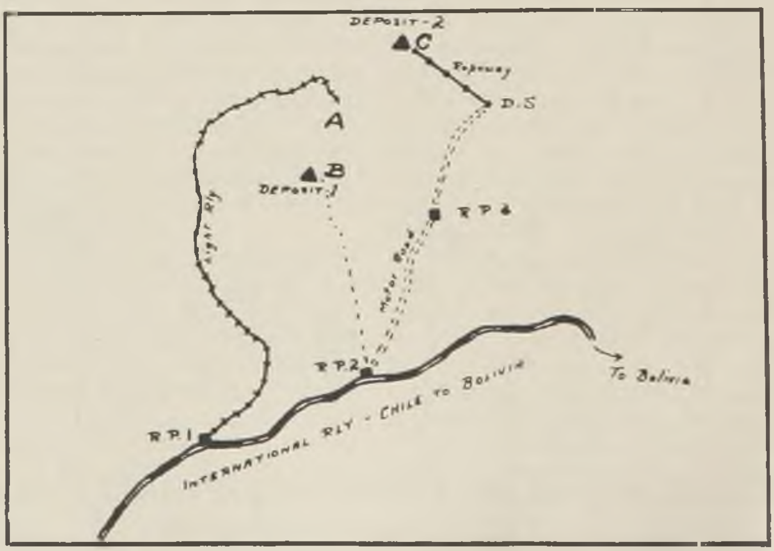


FIG. 1.—SKETCH SHOWING GENERAL LAY-OUT OF PROPERTIES.

refining plants was some 4,100 metres above sea-level.

The four methods of transport employed were: (*a*) Animal, (*b*) light railway, (*c*) aerial ropeway, and (*d*) lorry. These methods were employed as follows :—

Deposit 1, point " A "—by light railway to refining plant No. 1 (RP–1).

Deposit 1, point " B "—by animal to refining plant No. 2 (RP–2).

Deposit 2, point " C "—by aerial ropeway and lorry to refining plants Nos. 2 and 3 (RP–2 and RP–3).

In what follows these methods are described in more detail.

ANIMAL TRANSPORT.—For the transport of the ore mined at point " B " on deposit 1 to the refining plant RP–2, distant some 15 kilometres, llamas, the camel-sheep of the Andes, were employed (Fig. 2). Each llama was only capable of carrying a load of 100 lb. at a time and could do the round trip from the mines to the plant and back again in two days. Taking into account the fact that some 550 tons of ore were required per month and that a troop of llamas could only work some 10 to 15 days during that time it will readily be seen that great numbers of these animals were required for transport purposes. As most of the llamas had to be brought into the country from Bolivia and Peru, high prices had to be paid for transport and over a period of eight months amounted to $41·023 Ch. currency = £1 0s. 6d. per ton of ore transported, allocated as shown in Table I.

Transport of ore by llama was by contract —i.e., the owner of a troop of llamas was paid a fixed sum per ton of ore and was responsible for the maintenance of his animals, etc. There is no doubt that this method of transport was very costly, but, as the mines had been recently purchased and selling contracts had to be fulfilled llama transport was the only method available, pending the construction of roads and the arrival of mechanical conveyors, to keep the refining plant supplied with ore.

TABLE I

	Per ton of ore.	
Labour (contract) . .	$34·747 =	17s. 4½d.
Stores, tools, etc. . .	0·529 =	3d.
Sacks and string . .	5·530 =	2s. 9d.
Sundries	0·217 =	1½d.
Total cost per ton .	$41·023 =	£1 0s. 6d.

FIG. 2.—ORE TRANSPORT BY LLAMAS.

TRANSPORT BY LIGHT RAILWAY.—Ore mined on deposit 1 at point " A " was transported to the refining plant RP–1 by means of a light railway of 75 centimetres gauge, having an average grade of 3% (Fig. 3). Owing to numerous curves and the general topography of the ground the railway was 27 kilometres long, although in a straight line the distance between the workings and the plant was 13 kilometres. All rolling stock was of German manufacture and consisted of two steam locomotives, each of 125 h.p., and 12 side-tipping wagons, each with a capacity of six tons. A train usually consisted of one locomotive with a rake of six wagons and as only one trip per day could be made, owing to the stiff gradient and the large number of sharp curves in the line, the maximum amount of ore lowered per day was 36 tons per train.

The fuel used by the locomotives was

FIG. 3.—LIGHT RAILWAY TRANSPORT.

" yareta," a resinous moss of the genus *Azorella*, which grows in abundance on the mountain sides. This fuel cost $26·00 Ch. currency = 13s. per ton, the monthly consumption being from 45 to 50 tons per locomotive.

The average cost of transport per ton was $7·305 Ch. currency = 3s. 7½d., allocated as shown in Table II.

TABLE II

	Per ton of ore.	
Labour	$4·501 =	2s. 3d.
Stores	1·063 =	6¼d.
Insurance	0·323 =	1¾d.
Fuel (yareta)	1·418 =	8½d.
Total cost per ton	$7·305 =	3s. 7½d.

TRANSPORT BY ROPEWAY AND LORRY.—These two methods of transport are taken together, as the one was dependent on the other—i.e., the ropeway lowered the mined ore from deposit 2 to the discharge station (D.S.) at road-head, whence lorries transported the ore to the refining plants RP–2 and RP–3 (Figs. 4 and 5).

The aerial ropeway used for the transport of the mined ore from point " C " on deposit 2 to the discharge station (D.S.) at road-head was a Pohlig bi-cable, gravity operated, 4,600 metres in length, with a capacity of 10 tons per hour (50 buckets of 2,000 kilos each per hour). Owing to very strong winds being prevalent during the afternoon it was only possible to operate this ropeway for a maximum of eight hours in the morning, so the maximum tonnage lowered to road-head in any one day was only 80 tons.

FIG. 4.—AERIAL ROPEWAY FROM THE MINES.

Fig. 5.—Lorry Transport.

From the discharge station of the ropeway the ore was transported to the refining plants RP–2 and RP–3 by lorries, the distance between the discharge station (D.S.) and RP–2 and RP–3 being nine and five kilometres respectively. For this purpose a fleet of five "International" lorries, with self-dumping bodies, was employed, with the following capacities: Three "International" six-speed special lorries, each with a capacity of two tons, and two lorries of a similar make, each with a capacity of 2½ tons, making a total lorry capacity of **11** tons per trip.

Each lorry could make six trips per eight hours between the discharge station (D.S.) and refining plant RP–2 and eight trips per eight hours between the discharge station (D.S.) and refining plant RP–3. Lorry drivers and helpers were on a daily wage basis and transport of ore was not by contract. The average maximum tonnage that could be transported in this manner was 77 tons per day, the petrol consumption working out at 0·287 litres per ton-kilometre and costing $0·90 Ch. currency, or 5½d., per litre. The average cost of transport (ropeway and lorry) per ton of ore was $7·962 Ch. currency or 3s. 11½d., allocated as in Table III.

Table III

	Per ton of ore.	
Ropeway.		
Labour . . .	$0·982	
Stores, grease, etc. .	0·196	
Insurance . . .	0·084	
Sundries . . .	0·092	$1·354
Lorry.		
Labour . . .	$1·235	
Stores . . .	0·484	
Insurance . . .	0·172	
Petrol . . .	4·717	$6·608
Total cost per ton		$7·962 = 3s. 11½d.

Summarizing, the comparative table of costs per ton of ore transported shown in Table IV is obtained.

Conclusion.—It should be stated that previously these deposits were owned and operated by three different local companies,

Table IV

	Llamas.	*Light Railway.*	*Aerial Ropeway.*	*Lorries.*
Labour	$34·747	$4·501	$0·982	$1·235
Stores, tools, etc. . .	0·529	1·063	0·196	0·484
Insurance . . .	—	0·323	0·084	0·172
Sacks and string . .	5·530	—	—	—
Petrol	—	—	—	4·717
Fuel	—	1·418	—	—
Sundries	0·217	—	0·092	—
Totals . . .	$41·023 = £1 0s. 6d.	$7·305 = 3s. 7½d.	$1·354 = 8d.	$6·608 = 3s. 3½d.

who had their own ideas as to transport methods, etc. and, when the company by whom the writer was employed purchased and amalgamated the properties into one the best possible use had to be made of existing methods while new methods were being studied. It is rather curious to note that one of the original firms which owned deposit 2 and refining plant RP–3 should have installed a ropeway only to road-head D.S., instead of direct to the plant at RP–3 and thus doing away with the necessity of employing another distinct method of transport for taking the ore from the discharge station to the plant. It is true that a bigger capital expenditure would have been required, but on the other hand the outlay required for road construction and purchase of lorries, together with the monthly operating expenses incurred for wages of drivers, purchase of petrol, etc., would have been saved and would have paid for this extra length of ropeway over and over again, besides which a very much cheaper cost per ton of ore transported would have been obtained.

THE ANKOLE TINFIELD OF SOUTH-WEST UGANDA

By A. W. GROVES, Ph.D., M.Sc., D.I.C., F.G.S.

The author reviews two recent publications dealing with this part of the world and has something to say as the result of his own observations.

The recent appearance of two authoritative works,[1] one by Dr. H. A. Stheeman of the Central African Exploration Co., the other the official memoir of the Geological Survey of Uganda by A. D. Combe, gives us a vast amount of data concerning the Ankole tinfield and its surrounding country which will be welcomed alike by mining geologists, stratigraphers, and petrologists, in addition to those specially interested in tin deposits and the geology of Central Africa. The investigations on which the Government publication is based were the first to be commenced, but the difficulties attendant on geological survey work in Central Africa meant that ten years were to elapse between the commencement of mapping and the publication of the maps and memoir. As a result Dr. Stheeman's book, though dealing with work not commenced until 1929, was the first to appear in print.

The two books cover much the same ground, yet there is a great deal of matter which is not common to both. Thus the Survey Memoir extends farther afield to the Bukoba Province of north-west Tanganyika and as regards the ore deposits is largely concerned with Mwirasando, the principal mine, although all the other occurrences are briefly mentioned. Dr. Stheeman's book, which is the result of eighteen months' geological exploration and prospecting in the service of the Central African Exploration Co., a subsidiary of the Billiton Co., covers a more restricted area and deals solely with the occurrences falling within the prospecting area of that company. The mining and geological world owes a great debt to the Central African Exploration Co. for allowing the inclusion of the general information gathered by its geologists and engineers in the course of prospecting, geological mapping, and research work on a scale and at a cost that no academical mission or individual could afford. The book contains a good account of the geology of south-west Uganda, but its principal interest lies in the parallelism to be found between these stanniferous deposits and those of Mwirasando described in the official memoir. Moreover, the two books give the results of independent investigations of similar stanniferous deposits in the same field. In essentials the views of Stheeman and Combe on the genesis of these deposits are similar.

The Geological Survey publication is a comprehensive work, containing five colour-printed maps, of which four are on a scale of 1 : 50,000 and one on 1 : 500,000. There is also a map showing the distribution of the Karagwe-Ankolean System throughout East Central Africa and a map and cross-sections of the Mwirasando mine and ore-bodies.

[1] "The Geology of South-Western Uganda, with Special Reference to the Stanniferous Deposits," by Dr. H. A. Stheeman. Martinus Nijhoff, The Hague, 1932. Price Gld. 4.

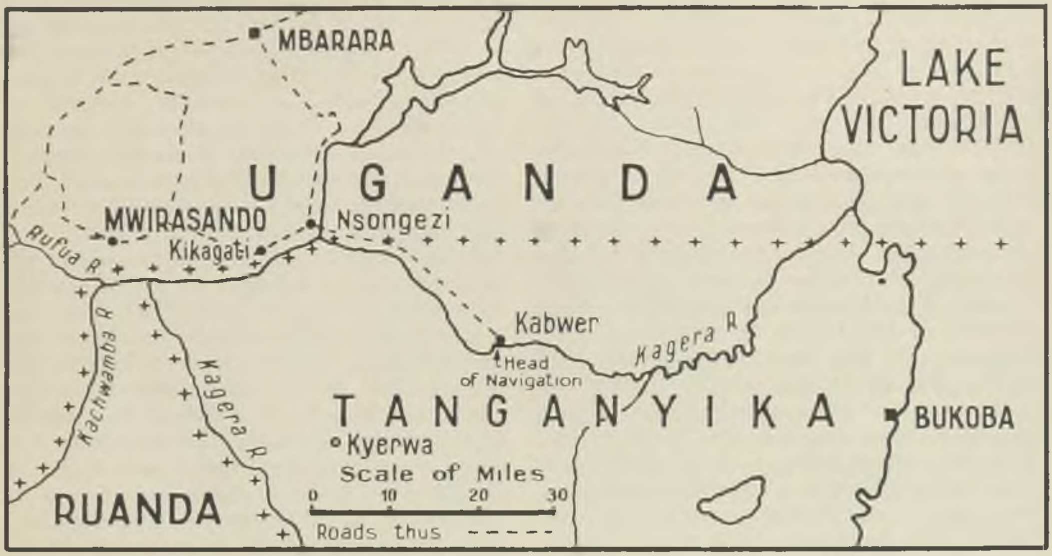
Geological Survey of Uganda. Memoir No. II. "The Geology of South-West Ankole and Adjacent Territories, with Special Reference to the Tin Deposits," by A. D. Combe, with an Appendix on the Petrology by Dr. A. W. Groves. The Government Printer, Entebbe, Uganda, 1932. Price 35s.

The author of these notes has contributed an appendix on the petrology of the rocks of the whole region and two further appendices by Mr. Combe dealing with the distribution and age of the Karagwe-Ankolean System are of particular importance to stratigraphers. Of the twenty chapters seven deal with the tin deposits and the genesis of the ore-bodies, while the rest are given to physical, descriptive, and historical geology. This is the most detailed account of the general geology of south-west Uganda and north-west Tanganyika extant. There is probably no one more skilled and experienced in landscape photography in these regions than Mr. Combe and the work is illustrated by thirty-two well-executed reproductions of his photographs. Some features in the mode of occurrence of the Mwirasando deposits are rare, if not unique, and an important part of the illustrations is, therefore, the series of cross-sections of ore-bodies—many no longer visible—and the plan of the mine complete up to June, 1930. The following epitomized account of the Ankole tinfield is based on these new books and the writer's own work on the region.

Uganda is one of the youngest of our Empire tin producers, yet from the year 1927, when production began, until the end of 1930 a total of 1,066 tons of cassiterite had been exported. The main belt of tin-bearing country, about 65 miles in length and 40 miles wide, occurs in south-western Ankole, but extends also into north-western Karagwe, in Tanganyika Territory. A feature of these cassiterite deposits is their freedom from other ore or deleterious minerals, the average assay value of the Uganda cassiterite being given as 74% of tin.

The principal mine in Uganda and the only one maintaining a regular production is that of Kagera (Uganda) Tinfields, Ltd., at Mwirasando (1° 0′ S., 30° 15′ 24″ E.), discovered in 1926, though a quantity of tin has been obtained from two other mines and from several places during the course of prospecting and exploratory operations. A new road has been constructed from the mine to Kabwer, the highest point at which the Kagera River is navigable. The river has now been cleared and buoyed from its mouth in Lake Victoria up to Kabwer, a distance of 120 miles, and river traffic is being conveyed in lighters towed by a shallow-draught twin-screw vessel fitted with Diesel engines. This water route enables lighters to go direct from the rail-head at Kisumu, in Kenya Colony, or Mwanza, in Tanganyika Territory, to a point on the Kagera that is about 60 miles from Mwirasando. This route has been used in conveying concentrating plant to the mine. It is hoped that traffic to and from the Belgian Ruanda will also use this route.

Over the field as a whole the cassiterite occurs in quartz veins, in masses and veins of muscovite and hydrous micas associated



Sketch Map of the Mwirasando Area.

with the quartz veins, and in quartz-muscovite-pegmatite veins. A considerable quantity of eluvial cassiterite has been picked up by hand on the outcrops of veins and upon the slopes below them. The pegmatites have not been found to be workable owing to the erratic distribution of the cassiterite in them. The quartz veins and the masses and veins of mica associated with them are the main producers.

ALLUVIAL DEPOSITS.—In view of the widespread distribution of cassiterite over south-western Uganda and the neighbouring parts of Karagwe (Tanganyika Territory), coupled with the richness of some of the veins and eluvial deposits, important stanniferous alluvial deposits might be expected, particularly in the valleys of the larger rivers such as the Kagera. In spite of persistent efforts, however, the search for alluvial tin in Uganda has met with little success. It is evident that such alluvial concentrations must have existed. They are, therefore, either buried under later alluvium and the swamps or else have suffered almost complete removal. Mr. Wayland, Director of the Geological Survey of Uganda, has made a study of the late geological and prehistoric climates of the region by means of stone artifacts. In this way he has shown that during the Pleistocene period in Uganda there were two pronounced pluvial periods separated by a dry one, the pluvial times in Africa corresponding to contemporaneous glaciations in Europe. Solomon and Leakey have come to a similar conclusion in connexion with their work in Kenya. It is to these pluviations that Wayland ascribes the removal of alluvial deposits from the small valleys, which are now mostly dry.

Stheeman does not accept this explanation. He doubts whether such a humid cycle has prevailed and states that even if it had its effects would have been neutralized by the tilting of Uganda in consequence of the Rift Valley movements, tilting which according to him had already taken place and given rise to much river reversal and rejuvenation. This differs radically from Wayland, who considers that the river reversal did not take place until the second pluvial period. Stheeman agrees that the alluvial deposits in rejuvenated rivers were removed, though by an increase of the gradient of the river bed in a sub-arid climate rather than the heavy precipitation of pluvial times. Elsewhere he believes the tin-bearing alluvials to be still "buried somewhere in the enormous swamps underneath detritus and bog." There are probably few tinfields which have necessitated such academic studies in order to follow the distribution of the alluvials. In view of the complicated nature of the problem such differences of opinion are only to be expected.

THE MWIRASANDO MINE.—The mine is situated within a few miles of two large granite masses (Younger Granite), while there is a small one only a mile away. Chiastolite has been found in the metamorphic rocks of the neighbourhood and it is therefore probable that granite may be present at no great depth. It is apparent here, as over the whole of south-western Uganda, that the tin is derived from these Younger Granites. The least altered of the country rocks of the Mwirasando mine are blue-grey phyllites, with a variable content of tourmaline. These become heavily tourmalinized and into them are injected the veins and masses of muscovite carrying cassiterite. A further type of country rock is represented by altered staurolite schist. The country rocks are all metamorphosed representatives of the Karagwe-Ankolean System.

The production of mica has been on a wholesale scale and while much of it is in large flakes some is in such microscopic crystals that the material resembles kaolin. The author believes that part at least of this fine material is kaolin[1] derived from the decomposition of beryl and topaz, while the breakdown of these minerals, as well as tourmaline, would also give rise to secondary muscovite. The quartz veins may give way at their margins to massive muscovite or the quartz vein may peter out and its place be taken by a mica vein. The cassiterite occurs in lumps of all sizes in these quartz and muscovite bodies, a peculiarity of the Mwirasando cassiterite being that it is usually veined with muscovite. Many of the cassiterite blebs occurring in pure quartz are similarly veined with muscovite, but the veins never continue into the surrounding quartz, suggesting that both the cassiterite and the muscovite veining it were formed before the quartz. Combe states that "Most of the cassiterite (of the quartz bodies) occurs in the brecciated parts of the quartz masses in association with much muscovite and in other parts where the aggregates

[1] It is probable that the beryllium-bearing mineral bavenite will be found here. (Cf. W. T. Schaller and T. G. Fairfield. *Amer. Mineral.*, 1932, vol. 17, pp. 409–422.)

and masses of muscovite are of frequent occurrence, that is mostly near the edges. It seems that the payable portions of the quartz masses will be confined to the parts in which the above stated conditions pertain, but a large part of the quartz appears to contain little tin. Whether or no the quartz bodies as a whole contain sufficient tin to warrant their extraction has still to be determined."

Large quantities of cassiterite have been obtained from the coarse muscovite aggregates and masses up to 18 in. in diameter have been found in them. Those veins characterized by the kaolin-like, finely-divided mica may also be rich in cassiterite and masses of ore occur in them as much as 4 ft. long and 1 ft. in thickness.

Other Occurrences.—The other deposits described by both Combe and Stheeman are in many ways similar as regards mode of occurrence to those of Mwirasando, but are much less productive. They are nearly all quartz veins, most of them being fringed with mica deposits, the country rocks being phyllites and quartzites of the Karagwe-Ankolean System. It is evident from the writings of both Combe and Stheeman that the bulk of the cassiterite and the ore with the best percentages is found in micaceous rocks. Accordingly the sericite phyllites are a more favourable host rock for stanniferous veins than the more arenaceous phyllites and quartzites. Felspar has never been observed in the stanniferous veins of Ankole and if originally present was undoubtedly sericitized and kaolinized. The output from these other occurrences has been small. The Kyerwa mine—just over the border in Tanganyika—exported about 150 tons of cassiterite between 1925 and 1929. The Kaina deposits yielded 12 metric tons of metallic tin in the years 1929–31.

Genesis of the Deposits.—Both Combe and Stheeman, as well as the writer, believe the production of mica in the phyllites to be akin to the greisenization of granites—i.e., that much of the muscovite was formed by the metasomatic alteration of the phyllites, the mineralizers having been brought up along the veins. The mica and tin were probably deposited more or less contemporaneously, but the formation of muscovite continued after the completion of the deposition of the cassiterite. There appears to be evidence of a second generation of quartz which has cut across the cassiterite and other minerals in such fine veins that it appears to have been introduced under great pressure.

Combe finds it difficult to determine the nature of the vehicle that brought along the tin and both he and Mr. W. C. Simmons (in a postscript) suggest that alkaline waters have helped to bring about both the cassiterite and the muscovite. They state that they are forced to this conclusion " because fluorine is noticeably absent from Mwirasando rocks, unless it occurs in the micas ; there being no topaz, and because tourmaline was always deposited prior to the coming in of the tinstone." The writer agrees with Combe that it is to be regretted this mica has not been analyzed, but there appear, nevertheless, to be good reasons why it should contain fluorine.

(*a*) It occurs together with tourmaline and, in the deposits other than Mwirasando, with topaz.

(*b*) The majority of muscovites contain fluorine.

(*c*) The neighbouring Chitwe granite yielded topaz and fluorite to the writer when average specimens were crushed.

(*d*) It is significant that nearly all the beryl at Mwirasando is largely altered to kaolin and mica.

(*e*) Stheeman asserts that tourmaline, one of the earliest minerals, is followed and partly replaced by mica.

From these data the writer considers it highly probable that fluorine was present in quantity and that it will be found in the mica. Furthermore, topaz, if originally present, may have completely altered to muscovite and kaolin. It is a difficult matter to find perfectly fresh beryl at Mwirasando. The comparative stability of topaz and beryl are not known, but topaz is attacked by sulphuric acid, whereas beryl is not. This seems to indicate that topaz, if originally present, would not have survived. Whilst agreeing that the solutions or vapours brought in alkalies for the formation of the mica, the writer believes that the fluorine necessary for the mica was also brought in by them and was the vehicle for the introduction of the cassiterite. Stheeman also appears to be of the opinion that fluorine was the carrier of the cassiterite. He states that " subsequent silicification has caused the disappearance, for the greater part, both of cassiterite and of mica. This is the fateful result of silicification and the thinner the stanniferous mica body the more complete was this effect." Consequently if this is correct the aluminous rocks, which were undoubtedly more favourable for the development of large and irregular muscovite bodies, are those wherein portions of the vein may have escaped subsequent silicification and the ore be preserved.

Depth of Erosion of the Field.—It is a difficult matter to assess the depth to which the Ankole tinfield has been eroded. With regard to other minerals occurring together with the cassiterite there are one or two records of wolfram, one of galena, and a few each of arsenopyrite and chalcopyrite. Combe says—" There is no assurance that there were higher successive zones characterized by the formation of arsenopyrite and wolfram, copper, zinc, and silver-lead respectively." Attacking the problem from the other end, the present writer found the heavy mineral assemblage of the G2 or Younger Granites (with which the tin deposits are associated) in the Bukoba Sandstone of the Bukoba Province of Tanganyika. The assemblage is complete and includes cassiterite, which can be matched with that of Ankole. In fact, for an arenaceous rock the content of detrital cassiterite in the Bukoba Sandstone is very striking. At the diagonally opposite end of Lake Victoria the Kisii Sandstone (which has been correlated with the Bukoba Sandstone) contains a similar Younger Granite assemblage, including the cassiterite. The Bukoba Sandstone is considered to be Waterburg in age, so that the stanniferous deposits of Ankole have probably been exposed to denudation for a long period of geological time.

On the foregoing evidence, therefore, it seems not at all unlikely that the Ankole tinfield is eroded down to one of the lowest mineral zones associated with granitic intrusions—that of cassiterite, unaccompanied by other minerals. The fact that the minerals of higher zones (ores of lead, copper, zinc, etc.) are not present in the Bukoba Sandstone is not considered to be an argument against this, since these minerals are unstable in sediments of great geological age ; those of the Dartmoor granite have not been found in the sediments of Southern England.

To sum up, it may be said that as regards the pegmatitic deposits Uganda provides no exception to the rule of their general uncertainty, but as regards the metasomatic deposits, in spite of their intimate connexion with the pegmatites, there appears to be much more promise. As Dr. Stheeman remarks, South-West Uganda forms part of an extensive area in which traces of tin have been found everywhere. There remain many of these Younger Granites to be investigated. Meanwhile the possibility that they may carry tin is not precluded, so that in the future these two publications may become of still greater value. Indeed, further interest already attaches to the area on account of its entry into the list of gold producers towards the end of 1931.

The I.M.M. Benevolent Fund

The following further subscriptions to the Benevolent Fund of the Institution have been received during the past month :—

	£	s.	d.
Ashanti Goldfields Corporation Staff	22	1	0
Taquah and Abosso Mines Staff .	11	11	0
Anglo American Corporation of S. Africa, Ltd.	10	10	0
Ipoh Tin Dredging Co., Ltd. . .	10	10	0
Minerals Separation, Ltd. . .	10	10	0
Mrs. P. Bosworth Smith . . .	10	0	0
Dr. S. W. Smith	10	0	0
Ariston Gold Mines Staff . . .	5	5	0
W. Pellew-Harvey	4	4	0
African Manganese Co. Staff . .	3	3	0
J. Ritchie	3	3	0
Captain R. P. Wild . . .	3	3	0
H. D. Allen	2	2	0
West African Diamond Syndicate Staff	2	2	0
A. R. Canning	1	1	0
J. Hume Taylor	1	1	0
Previously acknowledged . .	1,165	4	9
Total	£1,275	10	9

LETTERS TO THE EDITOR

"The Measurement of Air-Compressor Efficiencies"

Sir,—Mr. H. G. Smith in his article deals with the testing of air-compressors and in this connexion we would like to draw your attention to the booklet just issued by the British Compressed Air Society, which in its penultimate section deals with " Testing of Air Compressors and Exhausters." The test set out is that of the Heat Engine Trials Standing Committee on " Air Flow Measurement," reported to the Institution of Civil Engineers in December, 1931, and approved by their council. The society, consisting as it does of nearly all the manufacturers of compressors and pneumatic tools and appliances in this country, after very careful consideration adopted this report.

As Mr. Smith states it is clearly difficult to carry out an accurate receiver test, owing to the practical impossibility of correctly measuring the final temperature of the compressed air in the receiver at the end of the charge. The object of the test adopted by the Society is to determine the free air delivered (F.A.D.) by the compressor and from this figure and the power readings taken the various efficiencies mentioned in your article can be deduced.

The nozzle which is shown in Figure 2 of the article in your November issue is the old German nozzle of 1912 and this has been superseded in Germany and France by the Interessen Gesellschaft or I. G. nozzle of 1930, adopted by the Heat Engine Trials Committee and subsequently by the British Compressed Air Society. In the booklet referred to there is given a list of standard nozzles adopted by the society. No doubt larger sizes will be included in the future, but meanwhile the first six sizes are being produced and gauges have been made so that these nozzles will bear the stamp of the National Physical Laboratory, who are carrying out this inspection and stamping at the request and on behalf of the society.

For and on behalf of the British Compressed Air Society,

R. L. Quertier,
President.

47, Victoria Street,
Westminster, S.W. 1.
December 21, 1932.

The I.M.M. Benevolent Fund

Sir,—Last February you were good enough to publish a letter from me calling attention to the needs of the Benevolent Fund of the Institution of Mining and Metallurgy. At the same time you referred to the fund in your editorial columns and, as your readers will have noticed, have since published monthly details of the amounts received.

On behalf of the Committee of Management I should like to express their grateful thanks for this service, for we are confident that it is largely owing to this publicity that the income of the fund from subscriptions and donations has more than doubled compared with the preceding year.

The committee hope that they may rely on your continued support, which has been so effective during the past twelve months.

Hugh F. K. Picard,
Chairman.

Cleveland House, 225, City Road, E.C. 1.
January 2, 1933.

BOOK REVIEW

Flotation Plant Practice. By Philip Rabone. Cloth, octavo, 141 pages, illustrated. Price 10s. 6d. London: Mining Publications, Ltd.

In his preface the author states his objective was to produce a book which would not be voluminous and in which there would be no reference to obsolete equipment or methods. Cost and capacity figures were specially incorporated for the benefit of the field engineer, in order that they might be useful to him in the preliminary calculations he is so often called upon to make when away from home. The author has hardly done himself justice in imposing such a narrow limitation on the scope of the book he has produced. Actually it serves a much wider field and meets a real want of the student, the operator, and the engineer. The science of flotation is comparatively new, but the rapidity of progress by which its development has advanced during recent years has made it very difficult for any but the specialist to follow with full appreciation. The condensed form in which the author sets out the practical results of this progress will, therefore, make a special appeal to a very large number of operators and engineers, to whom the book will afford a valuable addition to their library for reference in times of need.

Apart from the introductory notes, the book is written in six chapters, in which the standard machines used in normal flow-sheets are described in ample detail and the layout of plant generally adopted for the recovery of different minerals from various ores is illustrated by excellent diagrams. The capacity and horse-power tables for these machines under varying load conditions are assembled in a form in which they will be equally valuable to the operator and the engineer and the tables of operating costs are segregated in sufficient detail to form a useful guide to operators. It would have been helpful to have had the unit figure for the cost of labour as well as for power. In the chapter on grinding the author wisely stresses the desirability of removing all material from the circuit as soon as it is sufficiently ground and points to the "over-conditioning" of the pulp and undesirable oxidation of the mineral that results from too long contact of the ore with water before flotation. In emphasizing these points he is doing a service by drawing attention to the need for greater efficiency in the means and art of classification. He points out clearly that grinding is not only one of the most expensive items of cost, but leaves the reader in no doubt that overgrinding is not efficacious to the attainment of the highest degree of metallurgical efficiency and should, therefore, be avoided. Various arrangements of circuits are illustrated, specifically designed to facilitate the removal of undersize mineral at the earliest stage, which will well repay careful study.

The explanation of the theory of flotation in chapter iv is written in language that will be understood and appreciated. It strikes the happy medium in being not too advanced for the student and not too elementary for the engineer. The function and classification of reagents with the general description of their uses for different classes of ores will assist the operator by suggesting to him possible alternatives by which his expenditure on reagents might be reduced with benefit to his costs and no loss of efficiency. In dealing with flotation machines the author confines himself to an explanation and description of the relatively small number which have survived the flood put on the market since the advent of flotation and been superseded in the march of progress which recent development has witnessed. The merits and demerits of each are outlined, having regard to the particular sphere for which experience has found it specially suitable.

Perhaps the most interesting chapter for the operator is that dealing with flotation methods, in which the author has gone to great pains to illustrate numerous types of circuits by which the best results have been secured under stated conditions. He is emphatic regarding the necessity for producing a high-grade concentrate in the interest of economy of cost in the subsequent conversion into metal and gives examples of typical flow-sheets and reagent consumptions for various classes of copper, lead, and zinc ores. In dealing with lead and lead-zinc ores he points to the common practice of recovering as much of the lead by jigs and tables as the degree of association of the respective minerals in the ore will allow. In the final chapter the handling of the concentrate and tailing is disposed of and the machines employed in this work are described and illustrated. The chapter ends with an appendix giving an estimate of the factory cost of machinery and buildings for flotation plants of varying capacities, with suggestions by which the completed cost of the plant can be roughly computed.

The author has produced in a very few pages a most interesting and informative book, which will find favour in a wide and appreciative field wherever the flotation of ores is practised or its theory discussed.

P. E. Marmion.

NEWS LETTERS

JOHANNESBURG

December 8.

Waterberg Gold Belt.—Mr. Stephen J. Lett, who has been investigating gold occurrences in the Waterberg district, Transvaal, states that the existence there of a gold belt over a distance of at least 20 miles, extending probably very considerably further in a more or less east and west direction, has been definitely established by the discovery of gold *in situ*. The mode of occurrence of the gold so far as at present ascertained is at least very unusual, as it is associated in the lodes with very considerable amounts of the oxides of iron, principally hematite and quartz. The gold has been located in reefs or lodes and some of this lode matter is very rich, whilst rock rich in gold has been found elsewhere on a protected farm. Hitherto the prospecting has been done by farmers experienced in such work and financial help is required, for the ground must be opened up, at least until solid country is reached.

Randfontein Extension.—The ground which was pegged by the Randfontein Estates recently is being opened up by means of a series of eleven winzes, over which headgears have been erected. Mining operations are being carried on day and night. This new section of the Randfontein mine presents a spectacle reminiscent of the early days of the Rand, when the bare veld was dotted with small wooden headgears connected by open trenches in which the reef had been laid bare. The reef strike, which is nearly 5,000 ft. in length, has been opened up by means of cross-trenching and open-cutting, while at intervals of approximately 500 ft. wooden headgears have been erected to serve the main winzes, from which the stoping of the ore will shortly take place. A main trackway, with compressed-air mains, cables, and water-service pipes, traverses the area to the west of the outcrop, from which connexions are made at each winze, where electric hoists are installed, together with small fans for the ventilation of the workings. Thus modern mining methods can be seen and studied on the surface instead of thousands of feet underground.

Western Areas.—It should be explained that in the past there has been considerable controversy in regard to the identity of the reefs exposed in the bore-holes put down over a quarter of a century ago on the Western Areas property, which has recently been purchased by the New Consolidated Gold Fields for the new prospecting company, West Witwatersrand Areas, Ltd. Leading geologists who investigated the ground in the past—viz., Hatch, Carrick, Corstorphine, and Molengraaff—held the view that the reefs intersected belonged to the Main Reef Series. At a later date (1912) the interpretation of Dr. E. T. Mellor, of the Geological Survey, caused opinion to incline to the belief that these reefs belonged to the Kimberley or Elsburg Series. Dr. Reinecke's recent investigation, however, in which he had the advantage of magnetometric interpretation, appears to have led finally to the conclusion, after two years of study of the problem, that the reefs exposed in the bore-holes definitely belong to the Main Reef Series. In one bore-hole visible gold was exposed in the core and there is no doubt that the bore-hole values on the whole can be regarded as very favourable, especially when it is realized that only a few good bore-hole results were obtained during the prospecting stage of even the richest of the Rand mines in the early days. On the Far East Rand very few bore-holes indicated payable results and gave, therefore, little indication of the values that lay beneath. As regards the 30 miles of country beyond the large block of farms known as Western Areas and in which the new company proposes to start drilling operations shortly, it is claimed that the sub-outcrop of the Main Reef Series has been traced within narrow limits. Neither Dr. Mellor nor the Geological Survey went beyond the Western Areas in their published investigations and throughout the 27 miles beyond there has been no confusion, as there has been in the case of the reefs in the Western Areas. Although it has always been recognized that the Witwatersrand system was intact under the dolomite, the position of the Main Reef sub-outcrop was hitherto unknown. Dr. Krahmann, with the aid of his magnetometric system of measurements, in co-operation with Dr. Reinecke, has now succeeded in locating the position of the Main Reef Series below the dolomite and this work marks an important forward stage in the development of this large area.

Liquid Oxygen Explosives.—Experimental work in the use of liquid oxygen explosives is being carried out at the East Geduld Mines. In the course of a paper read at a recent meeting of the Chemical, Metallurgical, and Mining Society of South Africa on the advantages of liquid oxygen explosives Messrs. T. Coulter and A. E. Lance stated that the savings accruing from liquid oxygen explosives appear to be at least 25% on explosive costs and when it is realized that approximately £2,000,000 is spent annually on the Rand on explosives it is possible, the authors stated, that some low-grade mines might be able to operate at a profit when using this explosive. Experience in South Africa in the breaking of diamondiferous ground, coal, and copper ore shows that by comparison with existing methods the economics of using liquid oxygen explosives are both sound and attractive. It is not contended that these explosives could be introduced on a Rand gold mine without certain modifications in the existing practice as regards blasting routine, but it is believed that the alterations necessary for the successful adoption of this system are not of an unpractical nature.

BRISBANE

November 23.

Mount Isa Activities.—According to the latest available report from Mines Department officials development work at Mount Isa, North Queensland, is still forging ahead, particularly in the Black Star section, where the ore-body is being blocked out for stoping. In the smelter section a good deal of work is in hand with a view to lessening the incidence of lead-absorption, which appears to have been on the increase in the last two weeks; otherwise work is running smoothly. A new daily record was made when 210 tons of bullion was produced on October 12 and a fresh weekly record when a quantity of 1,172 tons was the output for the period ended October 15. Underground work on the Black Star section included the operation continuously of the six glory-holes in this part of the mine, while the stripping of overburden at these glory-holes by means of scrapers was begun. Diamond drilling was continued underground and 138 vertical hole was advanced to 90 ft. Another weekly record in production was established in November, when the treatment plant put through 15,909 tons of crude ore. The recoveries in this week amounted to 1,130 tons of lead bullion, while for the same period 881 tons was railed to the port of Townsville. The following table shows not only the steadily increasing production in August, September, and October last respectively, but also the values of the metals recovered from the ore treated in those periods :—

	Aug.	*Sept.*	*Oct.*
Ore mined, tons	51,223	54,882	58,598
Ore milled, tons	50,035	52,391	60,149
Assaying—			
Lead, %	10·7	11·6	11·7
Silver, oz.	4·8	5·2	5·4
Lead Concentrates produced—			
Flotation, tons	8,808	10,143	11,533
Assaying—			
Lead, %	47·3	47·5	46·5
Silver, oz.	17·5	18·4	18·8
Jig, tons	—	—	746
Assaying—			
Lead, %	—	—	46·9
Silver, oz.	—	—	16·7
Silver-lead bullion produced, tons	3,771	4,406	4,373

Mount Wandoo Goldfield.—Regarding the Mount Wandoo gold mine, near Chillagoe, North Queensland, which caused considerable stir when first heard of last year, the latest reliable information available is that Mr. A. Macdonald, the lessee, has entered upon a regular system of development. An air-compressor was installed at the end of August and new Ingersoll-Rand drills are at regular work. The main (or Hardman) shaft has been sunk a further 48 ft., making its present depth 180 ft. In the last 55 ft. all sinking has been done on the foot-wall ore vein, with the intention of cross-cutting at depth to pick up the other known ore-bodies towards the hanging-wall. The crude ore in the sink has averaged 2 oz. of gold per ton, while a concentrate from the fines from the bin gave 15·5 oz. of gold and 32 oz. of silver. From the sink about 150 tons of ore, including a considerable quantity of gangue, has been raised and it is estimated that the bulk assay of all material will be in the vicinity of 1 oz. of gold to the ton. It is intended to open out levels at the 200-ft. mark when that depth is reached. At a point about 200 chains south of the Reid shaft in the same mine extensive exploratory development has been in progress and a large body of free-milling carbonates has been made available. A well on the field, the sinking of which was subsidized by the Government to a depth of 40 ft., has been extended to 60 ft., where, after passing through a hard granitic bar, a flow of water estimated at 3,000 gallons a day was tapped. This is proving a great boon to all employed on the field.

Cracow Field.—The latest newly-discovered goldfield in Queensland to create something of a sensation—that of Cracow, in the Central district—is still much in the public eye. Further leases have been taken up. Several of those previously held are being systematically and earnestly worked, either by permanent owners or by option companies investigating their potentialities. On many others, however, that were apparently taken up for speculative purposes, no work is being done, but the Minister for Mines has lately expressed his determination to see that labour conditions are in future strictly carried out. A Huntingdon mill being erected on the ground is about ready for use. It is near a dam that has been excavated, but cannot at present be put in commission until there is a fall of rain. The new field is in the neighbourhood of several old gold-mining areas that have been worked in the early days, but in no case has the auriferous ground been proved to exist at depth. The whole future of the field depends upon what may be found in the deeper country. A Government geologist is now examining the locality and his report, which is expected shortly, should help in the future development of the field and perhaps may give some information which will warrant the expenditure of substantial funds to prove its value.

Mount Morgan Again.—The sum of £15,000 advanced some time ago by the Queensland Government out of an amount available received from the Federal Government has now been spent and an application is about to be or has been made for a further advance. A report on the position at the mine has been made by Mr. H. W. Gepp, consultant on development to the Commonwealth Government, and forwarded to the Minister for Mines. Mr. Gepp says that, the first loan having been exhausted, provision to finance further work is necessary. The future expenditure, he states, will be between £1,100 and £1,500 a week, based on an equivalent to be spent on the present scale, and £300 to £400 for minor additions and experimental alterations to the mill. The concentrates being won each week weigh, approximately, 45 to 50 tons. Their value will vary, according to the grade of ore treated, from £20 to £30 a ton. Provided the mill operates continuously and metallurgical conditions remain under control, the income based on the present price of gold will, according to Mr. Gepp's estimate, be between £1,000 and £1,500 a week. The Queensland Minister, who has himself a good knowledge of mining matters, does not think the Mount Morgan company will need a great deal more assistance and this view is supported by the general manager.

Lake View and Star.—In a report on development in the Lake View and Star gold mine, Western Australia, in August, the management states that a horizontal diamond-drill hole at the Lake View 1,400-ft. level was extended to 430 ft. Only 30 in. of the core assayed sufficiently well to be considered ore, but a definite lode channel was disclosed. The management considers that the development is of major importance, despite the low values, because there is 1,400 ft. of ground overhead to be prospected.

Gold in Central Australia.—Many reports, most of them contradictory, have been received during the past month regarding the operations at The Granites, in Central Australia. The latest one, which comes from Melbourne and was published yesterday, is to the effect that two companies with interests on the field have decided to withdraw from active operations there and that only one company is now working on the field. The withdrawing companies are—The Granites Development, N.L., and Granites Gold, N.L. The company continuing to operate is one formed in Queensland by Mr. C. H. Chapman, managing director of Chapman's Gold Mines, N.L. The directors of Granites West, N.L., in Melbourne, have received an adverse report from two mining engineers, necessitating a withdrawal from the field, and a meeting of shareholders is to be called to decide on future action. Mr. Chapman, at the same time, has received advice from the management of Chapman's Gold Mines, N.L., stating that three drills had arrived and started drilling on a water bore. The report adds :—" Work on Bunkers Hill is cutting into values. A drive in No. 3 Burdekin Duck has been completed to join up with the main shaft. The Burdekin Duck main leader will be opened up for crushing on November 23. A new shaft on the Ajax lease is down 15 ft. A stamp-battery is expected to be on the field in three days."

TORONTO

December 17.

Metal Production of Ontario.—A report issued by the Ontario Department of Mines gives the total value of the metal production of the Province for the first nine months of 1932 as $47,976,638, as compared with $55,395,815 for the corresponding period of 1931. Gold was produced to the amount of 1,689,381 oz., of the value of $34,922,598, as compared with 1,526,887 oz., valued at $31,563,559. The production of silver shows a slight decrease at 4,769,532 oz., valued at $1,510,085, as compared with 5,111,504 oz., valued at $1,420,118. Large decreases were shown in nickel, copper, lead, and other items on the list. Gold mines of Ontario in November produced bullion to the value of $3,934,183, or $25,783 greater than the output for the preceding month. The improvement was due to the increased production in the Porcupine and North-Western camps, the former showing output valued at $1,841,137 and the latter $128,170, while Kirkland Lake, with a production valued at $1,964,876, showed a decrease of $7,800.

Porcupine.—The Dome Mines during November produced bullion to the value of $321,089, as compared with $308,513 for October, the increase being due to a slight improvement in the grade of ore. Some important new ore-bodies have been opened up, adding materially to the ore reserves. The 1,340-ft. level, from which high-grade ore has been taken out, is stated to be the best level so far opened up. The policy of the management is to keep millheads down to about $7 per ton and with this object in view workings on some high-grade stopes have been closed down. A financial statement of the McIntyre Porcupine for the six months ending September showed gross income of $2,899,850 and net earnings after all deductions of $1,127,720. The deep development programme is being steadily carried out and has resulted in some substantial new discoveries. In the Jupiter large tonnages of good-grade ore have been located. On the 600-ft. and 800-ft. levels of this section approximately 1,500 ft. has been opened up of an average grade of $12 per ton. Exploration will be carried down to the 1,875-ft. horizon. The future of the Vipond is entirely dependent on the discovery of new ore-bodies, the search that has been steadily carried on for some years having been unsuccessful. Some new ore has been found on the 1,450-ft. level, but it is of minor importance, and it is estimated that it would cost about $1,000,000 for new equipment and machinery to embark on a deep development campaign. The Canusa is being unwatered preparatory to systematic sampling and the resumption of operations. The company has secured sufficient funds for development on a large scale and if conditions justify to bring the property into production. The Coniaurum has made good progress in opening up new ore sections, which show better values than those found on the upper levels. The company is considering an extension of its programme of operations and an increase in mill capacity.

Kirkland Lake.—The Teck-Hughes during its fiscal year ending August 31 produced bullion to the value of $5,953,687, other sources of income bringing total revenue up to $6,824,239. After all deductions there remained $3,807,303 for dividends. That favourable results are being secured in the deeper workings is indicated by an official report, which states that on the ten levels below the 30th—from 3,605 ft. to 4,855 ft.—3,388 ft. of ore have been developed averaging $9·32. On the 35th level an ore-body has been encountered which on 125 ft. already opened up shows an average grade of $12·43 over a width of 12½ ft. At the Wright Hargreaves the central shaft has reached a depth of 3,500 ft. and the south shaft is down 3,700 ft. on its way to the objective of 4,000 ft. The enlarged mill will have a rated capacity of 1,200 tons daily, as compared with the present rate of 800 tons, and the company is steadily putting high-grade ore in sight on its bottom levels. The new horizons down to 4,000 ft. hold out promise of high-grade material. The Sylvanite is pushing development on the 2,500 ft. and 3,000 ft. levels, resulting in the opening of high-grade ore sections, Stations are now being cut at the bottom level at 3,000 ft. and diamond drilling will be started to test mineral conditions and geology at depth. Masassa has started development work on its new level at 2,325 ft. and assays taken over the first 30 ft. show $10·50 in gold per ton over the vein width of 5 ft. A second rise is going up from the 2,475-ft. level with the object of opening up new horizons. The Barry-Hollinger, in the Boston Creek area of the camp, has been refinanced by New York interests and a programme has been adopted for sinking and exploration work in the hope of finding better values at depth. The Miller Independence mine, in the same section, which has been closed for some time, is being unwatered and operations resumed.

Sudbury.—The quarterly statement of the International Nickel Company of Canada for the three months ended September 30 showed the first definite sign of improvement in more than three years of steady decline. The company is still operating at a loss, but the encouraging feature is that the net deficit of $629,327 shown in the previous quarterly statement had been reduced to $199,097. Sales of nickel and monel metal have been growing steadily. It was expected that operations at the Creighton mine and the Conniston smelter would be resumed in November, but the improvement in business was not considered sufficient to justify this course. Should the improvement continue these plants will be opened up in the near future. Falconbridge Nickel Mines has enlarged its furnace capacity by about 30% and can now treat about 500 tons daily. The company will operate at full capacity, as orders are on hand that will keep them busy for some time to come. There is much activity in prospecting and exploration in the Swayze gold district. The Kenty is putting down a shaft by hand steel and has ordered machinery that will be moved in over the winter roads. The Darragh group of claims is under option to the Kirkland Hudson Bay Mines and exploration has located several good veins on the surface. Machinery will be brought in as soon as possible and active development undertaken.

Other Ontario Goldfields.—In the Matachewan area the Ashley mine has begun steady production with millheads recently running $16·75 per ton. The Peerless Gold Mine Syndicate, operating in the same area, has been carrying on an active exploration campaign and opened up several surface veins carrying high-grade ore. The Parkhill, in the Michipocoten field, is completing alterations in its mill that will increase its capacity to 100 tons a day. Several previously-unexplored sections on and above the fourth level have been opened up, yielding a substantial increase in tonnage. At the Howey, in the Patricia district, development at depth is meeting with encouraging results. The mineralized zone 120 ft. wide at the 1,000-ft. level has widened out to 150 ft. at the bottom workings at 1,315 ft. The average grade of ore so far opened up in the mine is $4 per ton, while production costs are under $2·50. The relatively low costs are due to the massive nature of the ore. Stopes as wide as 80 ft. are being broken down, enabling the company to blast out huge tonnages at a single operation. The Central Patricia, which has been closed down for some time, will shortly be reopened. The company has been reorganized and has secured sufficient funds for an extensive development campaign, including the erection of a 50-ton mill.

North-Western Quebec.—Despite the low price of copper the Noranda is enabled to maintain its position by devoting its principal attention to the production of gold. For the nine months ended September 30 last the company showed net income from all sources of $2,819,853. The Siscoe during November produced bullion valued at $81,056 from the treatment of 5,472 tons, as compared with $80,352 from 5,618 tons in October. A new vein has been encountered on the 725-ft. level, some 4 ft. wide and showing much free gold. Good progress is being made with the work of increasing the power plant, which it is hoped will be in operation before the end of the year. At the Granada attention is at present largely concentrated on the programme of mill enlargement. Foundations are laid for the 400-ton ore bin and a large part of the mill machinery has been delivered. Underground work has disclosed a new vein on the 1,225-ft. level showing considerable free gold. Shaft sinking will be continued with the object of opening up two or three new levels to a depth of around 1,600 ft. The Treadwell Yukon has begun production at its property in the Pascalis area, the mill working steadily with millheads running between $10 and $12 per ton. Development work has disclosed a considerable extension of the mineralized zone which is being opened up. The Galatea Gold Mines Syndicate, operating in the Duparquet district, has met with good success in extending their mineralized zone, a series of high-grade lenses having been encountered that are stated to yield very high assays.

Manitoba.—Hudson Bay Mining and Smelting Company is maintaining production at a record rate and is showing good profits on operation. While the company's plant was originally designed to handle around 3,000 tons per day, for the last few months it has been treating about 4,300 tons. In addition to its high rate of copper and zinc production it is said to be obtaining about $2 per ton in gold extraction. Ore reserves are being steadily increased by active development. The Central Manitoba Mine is maintaining production and development work has revealed important new ore-bodies. Many prospectors have recently been attracted to the God's Lake area, located about 60 miles north of Island Lake in Northern Manitoba, where discoveries regarded as important were made during the past season. Staking has been actively carried on and many mining men are becoming interested in the field.

VANCOUVER

December 10.

Bridge River.—Operations at the Pioneer property, which is calculated to assume first place among the gold producers of the province in 1933, have got into their stride on the extended scale that is provided by the recent development and by the completion of the 300-ton mill. It is reported that the deep development is proceeding satisfactorily and that the main vein maintains its average width and value on the 13th level at a vertical depth of 1,500 ft. below the collar of the new shaft and 500 ft. below the level of the former deepest workings. On other levels—notably the 11th, where the cross-cut from the new shaft encountered the vein in a pinched section—driving work has resulted in proving a repetition of normal conditions of pinching and swelling and good ore-bodies are being opened up. Driving is in progress on all the new levels down to the 1,625 ft., where two headings are being carried on the main vein and the new vein respectively. The latter ore-body shows less regularity of strike and dip than the main vein, within the limits of the development to date, and further exploratory work is required for a definite appraisal of its economic importance. Lateral extension of the levels above the 1,000-ft. horizon is also productive of encouragement and continuity of the vein fissure has been proved in one or two instances beyond local faulting that had been supposed to bound the ore-body. Recent geological research by Dr. Howard T. James, who has been retained as consulting geologist by the company, and by Geological Survey parties that have been working in the field during the past two seasons tends to indicate somewhat different conditions affecting the mineralization of this area from the theories that were accepted previously. It is understood that there is a growing belief in the association of the fissuring with a rock-complex representing a highly-altered and partly-digested mass of volcanic and sedimentary rock invaded by dyke-like intrusions, rather than with a massive stock of a particular phase of batholithic intrusion. While this more recent interpretation may be considered as affecting the positive character of conclusions in regard to persistence of the economic ore in depth, such uncertainty may be offset by the additional possibilities that are indicated of a more general extension of the vein system. The dividend rate of the Pioneer has been doubled in the quarterly instalment that was declared recently. While no further confirmation is reported of the economic importance of prospects that have been investigated along the Cadwallader belt of the area, particularly those upon which a considerable amount of work has been done during the past season along the upper part of the valley, an interesting discovery has been made in another section. Gold ore that is said to be of an exceptionally high-grade has been discovered on the Merry Mac group of claims situated on Truax creek at a distance of a few miles north of the Pioneer. This section has been prospected intermittently for some years, but has been subject to considerable handicap on the score of access. It is stated that while the formation underlying this area in general belongs to the Bridge River series of sedimentary rocks, which up to the present time has not been found to be favourable to the occurrence of persistent ore-bodies, there appears to be a distinct relationship of the Merry Mac veins to granitic intrusion of a similar character to those of the Cadwallader belt.

Portland Canal.—Although the Premier mine is apparently approaching exhaustion, it will probably continue production for a few years yet, with gradual diminution of output. It is stated that diamond drilling work in the foot-wall of the north-east zone between No. 2 and No. 3 levels has indicated some small additional ore-bodies and that commercial ore has also been struck in similar work to the west of the No. 6 level. The Whitewater group of claims, the option over which was recently relinquished by Noah Timmins, is in a particularly favourable area in so far as topographical features are concerned, lying between the Premier mine section on the south and the Atlin district on the north and occupying a corresponding position on the east side of the coast range to the Juneau gold belt on the west. This last-named belt occupies an area approximately five miles wide and 100 miles long and includes about 100 localities that have been responsible for an output of gold for the past 50 years valued at between two and three million dollars. The area was the subject of investigation and report recently by F. A. Kerr, of the Geological Survey. Dr. Kerr points out that geological conditions are not equal in the two areas, inasmuch as the particular phase of the coast range batholith with which the Juneau belt mineralization is identified has been intruded and destroyed by a later phase characteristic of the eastern flank. He indicates that there are possibilities for the discovery of high-grade gold deposits of a different origin and cites the Whitewater belt as affording an example of what may be expected.

Cariboo.—Cariboo Gold Quartz Mining Company has been brought prominently to public notice recently in official reports and by the provincial mineralogist in his address before the meeting of the Canadian Institute of Mining and Metallurgy, in which he referred to the property in terms of considerable encouragement. The commencement of milling operations has been delayed by weather conditions, but it is anticipated that the mill, with an initial capacity of 75 tons per day, will be in operation before the end of the year. The mine developments are said to be particularly encouraging, eight veins, with considerable promise of developing tonnage, having been opened up. The result of these developments is held to be of significance in relation to the whole belt of lode-gold mineralization in the Barkerville area and it is said that the evidence which is now available warrants careful investigation of numerous places where surface showings have not proved to be of particular attraction. The cross-cut tunnel that was started just above Jack of Clubs Lake has now been driven for a distance of over 1,400 ft. The original object of this work was to investigate the showings on the Rainbow claim, which were expected to be reached in a distance of 3,000 ft., and it was anticipated that other veins would be encountered *en route*. Of the eight veins that have been cut, only numbers 1, 2, and 5 have been driven on, but it is estimated that the average width of all of them is about 3 ft. and the results of a careful check sampling have indicated an average gold value of $18·55 per ton. As at present developed, no large tonnage of ore is definitely blocked out, but it is said that ore should be proven rapidly in connexion with the series of veins already available for exploration from the No. 15 level and some very interesting probabilities of ore disclosures lie ahead of the present workings. On the No. 5 vein a rise has been put up to surface and a new level, No. 12, is being driven from it to tap the downward continuation of the Rainbow showings, including a nine-foot vein that was exposed in upper workings where values of $10 per ton in gold were obtained over a distance of 150 ft. The distance to drive is somewhere around 1,500 ft., giving a depth below the Rainbow surface showings of approximately 400 ft. Substantial camp buildings have been erected and new power equipment is being installed. The operations are said to be in charge of a competent staff and, according to J. D. Galloway, the property is destined to become one of the leading gold producers of the province. It is interesting to note that the probabilities as outlined above were forecast by the late W. L. Uglow in his report on the Barkerville area that was published several years ago.

Nelson.—In outlining the probabilities of gold supply recently, the provincial mineralogist drew attention to the importance of the aggregate production from the smaller mines of the Nelson, Ymir, and Sheep Creek areas. A number of abandoned mines have been reopened during the past season, of which the Juno and Venus groups are a typical example. These properties are situated close to Nelson, on Toad Mountain, and together with the adjoining Athabasca property were operated at considerable disadvantage in regard to costs of operation as well as to knowledge of the conditions of mineralization many years ago. With the later exception of desultory attempts to mine some pockets of easily-won ore, they have lain idle until they were acquired under lease by a group which has been carrying on systematic development and exploration work during the past season. An amount of about 123 tons of ore of an average grade of $10 per ton has been shipped from workings that have a distinct value in pointing to both lateral and depth persistence of the ore-bodies. As described by the Government resident engineer there are several definite objectives for developing ore with a limited amount of work and these are in relation to extension of tunnel workings that were abandoned on account of failure to recognize the flat rake of the ore-bodies. By amalgamation with the Athabasca property an opportunity would also be provided for deep approach under favourable conditions. The Venus mine was developed originally by means of eight drift levels, of which six are adit tunnels, and it is said that good assays have been obtained from numerous samples taken along the floor of the lowest of these tunnels. With modern methods of treatment it is estimated that good recoveries can be made and the resident engineer states that the thorough investigation of the old workings which has been carried out by the present experienced miners has made it possible in general to form more definite impressions of potentialities of these and similar properties in the district.

Vancouver.—In a statistical review that was presented at the recent meeting of the Canadian Institute of Mining and Metallurgy by J. D. Galloway it was estimated that the total mineral production for 1932 would have a value of $28,000,000, representing a decrease as compared with 1931 of 20%. It is satisfactory to note that in face of this general decline—which is, by the way, attributable in a preponderating degree to low prices—an actual increase of about 25% is to be recorded for lode-gold production. It is estimated that the anticipated continuance of the upward tendency in this branch of the industry will result in a total valuation for the 1933 production of $5,000,000.

East Kootenay.—An interesting theory of the origin of the base-metal deposits in the Cranbrook area, including the big Sullivan mine, has been submitted in a preliminary report by C. E. Cairnes, of the Geological Survey. The association of these characteristic high-temperature deposits with igneous intrusion has been recognized, but the problem of their genesis has been complicated by the entire absence of any outcrops or discovery of batholithic stocks in the area.

It is now suggested that the origin of the mineralization, which is of typical replacement type, is in association with the series of highly-altered and mineralized Purcell sills which are found intruding the Aldrich formation in particular that constitutes the host-rock of most of these deposits. The significance of this association has a wide field of application in connexion with prospecting in the district and encouragement is given to search in localities particularly where these sills are found to split, with possibilities of reuniting to enclose areas of sedimentary rocks under conditions favourable to replacement.

Boundary.—Hecla Mining Company has suspended operations at this property for the winter and is confining work to exploration on the adjoining properties that were acquired recently. It is understood that there will be no cessation in the activity along these lines and that diamond drilling work is to be prosecuted vigorously. Failure to discover any repetition of the exceptionally high-grade ore-shoots in the Union mine workings was responsible for this decision, but the attraction of the camp generally in affording possibilities of discovery of similar deposits elsewhere is justification for continued exploration.

Hope.—The Dawson mine, formerly known as the Emancipation, is now owned and is being operated by Verona Gold Mines, Ltd., a private organization representing Vancouver capital.

Atlin.—Dr. J. T. Mandy, resident engineer for the north-western district, reports favourably on the Squaw Creek area where parties of prospectors have been working during the past two seasons. Dr. Mandy made a visit of inspection recently and confirms the reports of high recoveries that are being made from placer ground in addition to advancing suggestions in regard to dredging possibilities and of favourable opportunities for lode-gold operations. White men and Indians that are working shallow ground on favourable rim rocks are said to be earning from $5 to $60 per man per day. Squaw Creek is a tributary of the Tatshenshini River, which has its source in Yukon territory and flows down through Alaska. The creek rises in British Columbia and flows northerly. The area is reached from Haines, Alaska, by motor-road to Pleasant Camp at the head of Lynn Canal and thence by trail, the total distance being about 100 miles.

PERSONAL

R. J. Agnew has left Italy for Western Australia.

Nigel C. Cooke has returned to Nigeria.

K. O. de Veer is now in Portugal.

P. C. Delaitre has returned to Paris from French Guiana.

J. V. N. Dorr has been elected to an advisory committee of the College of Engineering of New York University.

J. L. Ford is returning from Nigeria.

E. R. Fordham is returning from Burma.

Victor Hodgson has returned to India.

A. W. Hooke has left for Dutch Guiana.

Ross Knuckey has left for Turkey.

R. Mellon has returned from India.

Eric Newbold is returning from Straits Settlements.

B. Novikoff is returning from Trinidad.

J. W. Pertwee is leaving for Mexico.

Charles Salter has returned to Singapore.

George A. Smith is now in Portugal.

G. W. Thompson has returned to New Zealand from Australia.

W. E. Thorne has returned to Colombia.

H. T. Tizard, Rector of the Imperial College, has been appointed Chairman of the Aeronautical Research Committee.

C. H. Trezise is returning from Nigeria.

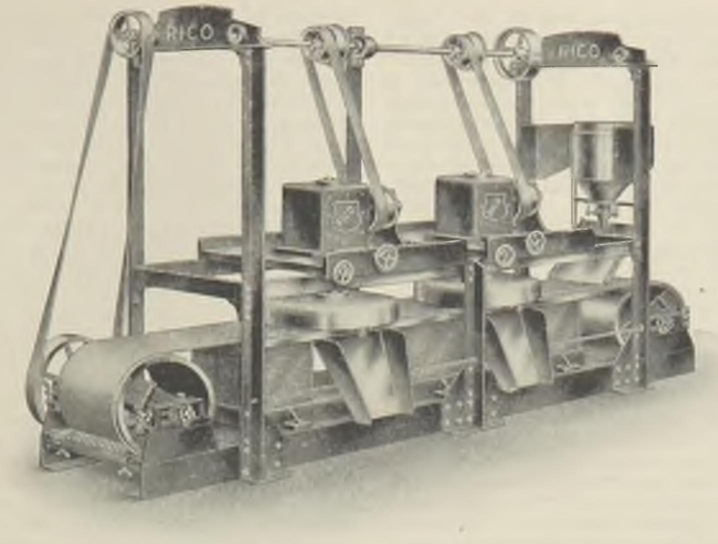
C. C. Walker is now in Burma.

Edward Heberlein, who died in Paris on December 22 at the age of 53, was one of 11 brothers, several of whom distinguished themselves in metallurgy, Dr. Ferdinand and Dr. Cuno particularly. Following early training at Zurich and Klausthal, Edward Heberlein took his degree of Doctor of Science at Geneva University. After being associated with Dr. Huntingdon and his brother Ferdinand in the development of the Huntingdon-Heberlein lead-sintering process he came to London in 1903 to join tl. firm of H. J. Enthoven and Sons, at Rotherhithe, of which he eventually became managing director. About 1915 he left the firm to set up in consulting practice and at this time was associated with Mr. Tilden Smith, taking an active part in the development of the Burma Mines, the predecessor of the Burma Corporation. Dr. Heberlein's consulting work took him to Canada, where he advised in connexion with the Trail smelter, and more recently worked in co-operation with the inventor of the Harris process for lead refining, which again brought him into contact with his old firm.

TRADE PARAGRAPHS

Mavor and Coulson, Ltd., of 47, Broad Street, Glasgow, report that they have received an order, through their South African subsidiary company, from the South African Coal Estates, Ltd., for coal-cutting machinery to be used in connexion with the production of coking coal for the new steelworks at Pretoria.

Sir Isaac Pitman and Sons, Ltd., of Parker Street, Kingsway, London, W.C. 2, have published parts 5 and 6 of their *Engineering Educator*, which issues contain further chapters on machine construction and drawing, the continuation of the subject of applied mechanics, which includes graphic statics, and a further chapter on the elements of mechanism.



Rico-Wilfley Magnetic Separator.

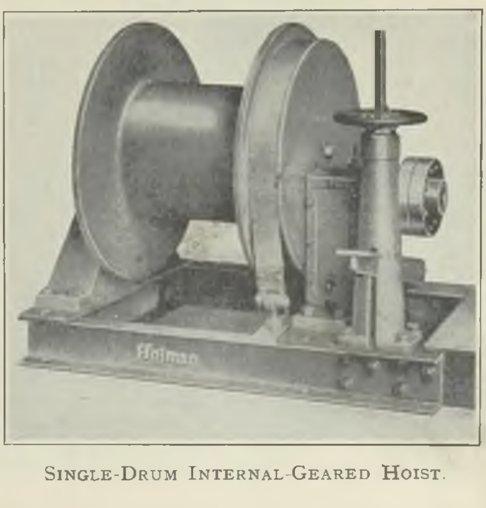
Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, in their *Metropolitan-Vickers Gazette* for December have an article describing electric winding equipments at Broken Hill, Australia, to which installations attention has already been directed in the Magazine. There is also the conclusion of an article on the choice of a motor for mining service.

Adam Hilger, Ltd., of 98, King's Road, Camden Road, London, N.W. 1, issue Bulletin No. 4 with regard to spectrum analysis, which contains an up-to-date bibliography of the subject. They also issue a leaflet describing the non-ferrous Spekker, which is a spectroscope specially designed for the rapid estimation of metallic elements in non-ferrous metals. Besides describing the instrument it contains full information as to its use.

Mining and Industrial Equipment, Ltd., of 11, Southampton Row, London, W.C. 1, report having received the following orders: For England: One LM. 7 Lopulco mill for marl, two Ro-Tap testing sieve shakers, and one 3 ft. diameter Raymond air-separating plant for hydrated lime. For South Wales: One 6 ft. by 36 in. conical mill for anthracite and two LM. 5a Lopulco mills for the same. For abroad: One 4 ft. 6 in. by 16 in. conical mill for mineral ore. For the Sudan: One 3 ft. diameter conical mill for friable quartz ore. For South America: One 18 in. Andrews hydraulic classifier and one 5 in. grit pump for use in conjunction with it on a gold ore.

Wilfley Mining Machinery Co., Ltd., of Salisbury House, London, E.C. 2, issue a pamphlet describing the Rico-Wilfley magnetic ore separator, one of which is illustrated here. This is primarily intended for dealing with feebly-magnetic material and its principal function is to free magnetics from ores such as wolfram-tin, zinc blende, monazite sands, etc. As will be seen the separator is of the disc type, the ore passing along an endless belt and under the revolving disc or discs, the magnetic product being discharged on either side of the disc. Machines are supplied in three different sizes corresponding to belt widths of 8½, 12½, and 16½ in. and each size is made with either two or three discs and three or four poles. The current consumption of the smallest size is of the order of 10 amps. and of the largest 28 amps.

Holman Bros., Ltd., of Camborne, Cornwall, publish particulars of their single-drum internal-geared hoists, one of which is shown in the accompanying illustration. The drive is transmitted through a pin-type flexible coupling, one half of which is keyed to the motor-shaft and the other to the first-motion shaft. The latter is splined and carries a sliding pinion that, serving as a clutch, may be moved in or out of gear with the spur wheel on the second-motion shaft by a self-locking hand-lever. On the second-motion shaft there is also a pinion meshing with the internal spur ring attached to the drum. Both shafts are mounted on ball and roller bearings and all gearing is machine cut, the first pair running in

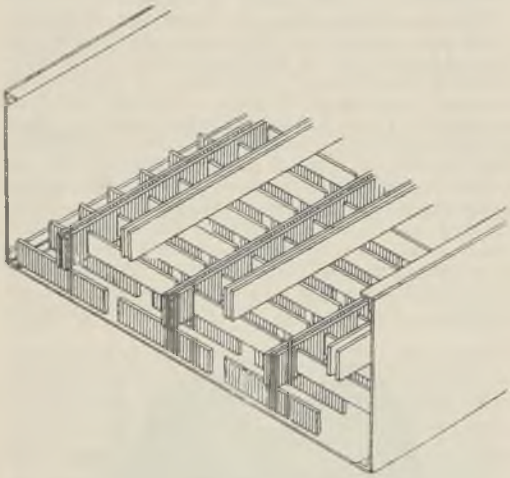


Single-Drum Internal-Geared Hoist.

oil in a totally-enclosed gearbox. A steel guard protects the second pair, provision being made for grease lubrication. The foot-operated brake is of the Ferodo-lined band type. The hoist may be driven by means of an air motor or an electric motor, the Holman H.S.B. air motor being eminently suitable in the first case. The hoists are made in two sizes corresponding to mean rope pulls respectively of 2,000 and 4,000 lb., the brake horse-power in each case varying from 15–20 and 30–40.

Buck and Hickman, Ltd., of 2–8, Whitechapel Road, London, E. 1, issue a booklet describing Blackor, the product of the **Blackor Company,** of 13007, South Main Street, Los Angeles, California, U.S.A. This is a hard facing material in the form of a powder, which is applied to the surface of the material to be hardened by means of the carbon electric arc using a d.c. welder operating at from 40–60 volts and 40–300 amps. By means of it the hardness of surface of such metal parts as drill bits or the wearing parts of mechanical excavators—i.e., the bucket teeth—can be greatly increased. The booklet contains full descriptions of the method of its application. It may be similarly employed for core-drilling bits.

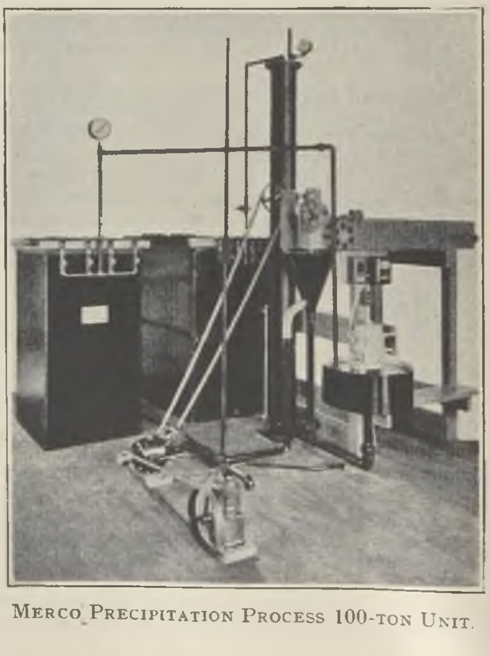
General Engineering Co., Inc., of Adelaide House, London, E.C. 4, issue a bulletin describing their "Geco" double-acting classifier, which is of reciprocating rake type. In an introduction they point out that closed-circuit grinding has rendered indispensable some form of classifying apparatus



"Geco" Douele-Acting Classifier.

for the separation of sand from slime and that the development of such apparatus has been along three main lines—viz., ribbon conveyors, raking blades on endless belts, and raking blades attached to a reciprocating bar. All three operate in an inclined tank, forming a pool at the lower end from which the slime overflows, the sand being raked up. After pointing out the defects inherent in all three types they proceed to indicate how they have endeavoured to overcome these several difficulties. By a special mechanism the raking capacity of the ordinary classifier of the third type mentioned has been practically doubled, while incidentally a cleaner sand is made and a denser overflow obtained. The drawing reproduced here indicates the essential features of the raking mechanism, from which it will be seen there are two sets of blades acting independently. While one set is moving up the slope, the other set is travelling back over the first set. When this second set arrives for the commencement of a stroke it descends and its blades pass between the blades of the first set, which rise for their return movement. The raking motion is thus almost continuous and the sands are not allowed to slip back.

Merrill Company, of 343, Sansome Street, San Francisco, California, U.S.A., publish a leaflet describing new modifications in the Merrill-Crowe precipitation process. Cyanide operators are familiar with this process and it is therefore only necessary to say that this is recognized as an efficient and economical method of precipitating gold and silver from cyanide solutions. Modifications herein alluded to have aimed at reducing the equipment cost of the process and at the same time an improvement has been effected whereby there is simultaneous clarification, de-aeration, and precipitation. A typical installation is shown in the accompanying illustration. A single centrifugal pump is used to effect the successive steps of clarification, de-aeration, and precipitation. The larger rectangular tank is kept filled to a constant level with unclarified solution, the inflow being controlled by an automatic float valve. Suspended in this tank are vacuum clarifying leaves with outlets connected to a manifold, which in turn is connected to the top of the vertical tower where the solution is de-aerated. A second pipe connects the top of the de-aerating tower with the vacuum pump shown in the foreground, the pipe being carried up to sufficient height to form the usual barometric seal. Within the tower the solution passes down through suitable screens or grids, which break up the flow into small streams and films, thus effecting the substantially complete removal of dissolved oxygen. The clarified, de-aerated solution is withdrawn from the bottom of the tower by a vertical single-stage centrifugal



Merco Precipitation Process 100-ton Unit.

pump submerged in solution to prevent re-entry of air through the pump gland. It has been discovered that, by locating the pump at a suitable height above the bottom of the tower and using a pump of ample capacity for the required solution tonnage, the tower will neither empty itself nor fill above a certain height, as indicated on the solution gauge attached to the tower. The use of this arrangement obviates any form of float control within the tower, thus permitting the use of much simpler and smaller towers and effecting a substantial saving in cost. Zinc dust emulsion is introduced to the pump suction at a point midway between the pump and the vacuum tower. A continuous and uniform feed of zinc dust to the emulsion cone is supplied either by a belt-type feeder or by the recently-developed revolving drum feeder. Precipitated barren solution is supplied to the cone by a pipe connected to the smaller or barren solution tank and the mixture of zinc dust and solution is discharged from the cone by a mechanically-operated valve. This discharge valve is opened and closed by a cam and adjustable tappet operated by the zinc feeder, thus permitting a steady and uniform introduction of zinc emulsion. Less than one gallon per minute of oxygen-free barren solution is discharged by this mechanically-operated valve. The clarified, de-aerated solution, now containing the proper amount of zinc dust, is forced by the centrifugal pump into cylindrical pressure filter bags suspended in the barren tank. Precipitated solution, flowing from the bags into the tank, overflows through a weir and thence to barren solution storage. The pressure filter units consist of an outer bag of heavy canvas and an inner bag of sheeting. Clean-up is effected by raising the bags, blowing with air, and removing the inner sheeting bag containing the gold-silver precipitate. After adding flux the sheeting bags are rolled up and burned in the melting pot, followed by the usual fluxing and melting. If preferred, the bags may be washed and re-used, in which case the washings are filtered and the precipitate melted as usual. The former method is preferred, since it involves absolutely no handling of precipitate.

METAL MARKETS

Copper.—The tendency of prices was rather easier during December on the whole and while standard values lost some ground, despite minor reactions, electro fell from about 5·32½ cents per lb. c.i.f. Europe to 4·85 cents by the middle of the month, recovering however to 5·10 cents. The War Debts sensations and the collapse of the international producers' conference in New York were factors which tended to keep confidence throttled down—if any confidence can be felt in a market such as copper, when nearly a million tons of surplus metal is held in stock. It is possible that 1933 may witness a fierce price-war, which would result in the elimination of some of the higher-cost producers.

Average price of Cash Standard Copper: December, 1932, £29 2s. 7½d.; November, 1932, £32 0s. 4d.; December, 1931, £38 6s. 5d.; November, 1931, £35 18s. 1d.

Tin.—Quotations were kept fairly steady throughout December, although perhaps at the close the undertone was rather undecided. "Pool" support has been mainly the explanation of the steadiness of prices, for industrial demand, despite moderate buying in Britain and on the Continent, has not been good. Until the United States gets industrially active once more the market will inevitably be deprived of much of its normal support. So far the drastic steps taken by the International Tin Committee have not succeeded in reducing the "visible supplies" very heavily, but during December a further moderate reduction was witnessed. The rate of improvement in the statistical position is, however, painfully slow.

Average price of Cash Standard Tin: December, 1932, £149 17s. 9¾d.; November, 1932, £153 13s. 3d.; December, 1931, £138 19s. 7d.; November, 1931, £132 18s. 10d.

Lead.—Prices had an easy trend during December, which was not surprising in view of the announcement that world stocks had expanded to over 500,000 tons. While good arguments can be adduced why lead should benefit when trade ultimately revives it is obvious that the existence of these stocks tends to undermine confidence in the position. Industrial demand has remained rather quiet. In some quarters it is urged that producers should take prompt steps to curtail output farther before the statistical situation gets out of hand.

Average mean price of soft foreign lead: December, 1932, £11 6s. 10d.; November, 1932, £12 4s. 7d.; December, 1931, £15 5s. 5d.; November, 1931, £14 10s. 8d.

Spelter.—Values were maintained pretty effectively during December, but towards the close of the month sentiment became somewhat nervous in view of the obscurity surrounding the proceedings at the recent International Zinc Cartel meetings. Some members are insisting on their being granted larger production quotas, but as this would probably call a halt to the marked trend towards statistical improvement—the stocks held by the cartel have fallen substantially during 1932—other producers are reluctant to agree to this. At the moment of writing the fate of the cartel seems to be doubtful, but it is reported that a provisional arrangement covering January has been made.

Average mean price of spelter: December, 1932, £15 5s. 6¾d.; November, 1932, £15 7s. 11d.; December, 1931, £14 11s. 9d.; November, 1931, £14 0s. 10d.

Iron and Steel.—The British iron and steel market continues to present a fairly cheerful aspect and it seems clear that works in this country are benefiting to some extent from the import tariffs. Whether this benefit will prove permanent or merely temporary in the long run nobody can yet say. The imports of Continental pig-iron and semi's have, of course, been severely restricted by the duties, while the depreciation in sterling is another factor which assists in protecting the home market and stimulating sales of British material abroad. Unfortunately export trade is now so badly hampered by the multifarious restrictive regulations operative throughout the world that British industry is not able to benefit as much as it would otherwise have done by our country leaving the gold standard. Cleveland pig-iron remains steady, with No. 3 foundry, g.m.b., still priced at 58s. 6d. for local delivery. The outlook in the British finished steel industry is believed to be improving, but the time of year has militated against a pronounced expansion in business.

LONDON DAILY METAL PRICES.

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

	COPPER.				TIN.		ZINC (Spelter).	LEAD.		SILVER.		GOLD.
	Standard.		Electrolytic	Best Selected.				Soft Foreign.	English.	Cash.	Forward.	
	Cash.	3 Months.			Cash.	3 Months.						
Dec.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	s. d.
12	27 6 3	27 13 9	33 0 0	—	149 3 9	150 6 3	14 15 0	10 17 6	12 10 0	17½	17 9/16	126 2
13	28 0 7½	28 8 1½	33 12 6	30 5 0	149 13 9	150 16 3	15 1 3	11 0 0	12 10 0	17 5/16	17⅜	126 5
14	27 15 7½	28 1 10½	33 5 0	—	148 7 6	149 7 6	15 1 3	10 18 9	12 10 0	17⅜	17 3/16	125 6
15	27 16 3	28 3 1½	33 5 0	—	149 3 9	150 8 9	15 7 6	11 0 0	12 10 0	17 1/16	17⅛	125 3½
16	28 1 3	28 8 1½	33 5 0	30 5 0	149 13 9	150 17 6	15 7 6	11 2 6	12 10 0	17	17	124 9½
19	29 1 10½	29 9 4½	34 10 0	—	149 10 0	150 16 3	15 11 3	11 7 6	12 15 0	17	17 1/16	124 1½
20	28 15 0	29 1 3	34 0 0	31 0 0	149 2 6	150 11 3	15 8 9	11 3 9	12 15 0	16 15/16	17	123 8
21	28 4 4½	28 11 10½	34 0 0	—	148 17 6	150 3 9	15 6 3	11 1 3	12 10 0	16 11/16	16 11/16	123 5
22	28 1 10½	28 8 1½	33 15 0	—	148 12 6	150 0 0	15 7 6	11 0 0	12 10 0	16 9/16	16⅝	123 4½
23	28 3 9	28 10 0	34 0 0	31 0 0	148 13 9	149 18 9	15 7 6	10 16 3	12 10 0	16 13/16	16 13/16	123 11
28	28 11 3	28 18 9	34 0 0	31 0 0	148 8 9	149 17 6	15 8 9	10 15 0	12 5 0	16½	16 9/16	123 8½
29	28 18 1½	29 5 7½	34 8 9	—	149 3 9	150 6 3	15 6 3	10 15 0	12 5 0	16⅜	16 7/16	123 11
30	28 13 9	29 0 0	34 7 6	31 10 0	149 2 6	150 2 6	15 0 0	11 0 0	12 10 0	16 7/16	16½	124 5
Jan.												
3	28 16 10½	29 4 4½	34 10 0	31 10 0	147 18 9	148 16 3	14 18 9	10 13 9	12 5 0	16½	16 9/16	123 8
4	28 1 10½	28 9 4½	33 15 0	—	141 2 6	142 2 6	14 8 9	10 7 6	12 0 0	16 9/16	16⅝	123 4
5	28 5 0	28 12 6	33 5 0	—	144 7 6	145 7 6	14 11 3	10 8 9	12 0 0	16⅞	16 15/16	123 1½
6	28 6 3	28 13 9	33 15 0	30 15 0	144 7 6	145 2 6	14 11 3	10 5 0	11 15 0	16 11/16	16¾	123 1½
9	28 16 10½	29 3 1½	33 15 0	—	145 7 6	146 2 6	14 15 0	10 6 3	11 15 0	16 13/16	16⅞	123 0
10	28 18 9	29 5 7½	34 0 0	31 5 0	146 8 9	146 18 9	14 12 6	10 5 0	11 15 0	16¾	16 13/16	122 10

Iron Ore.—One or two good contracts have been placed for 1933 delivery, but generally speaking the market remains very quiet. Until the pig-iron output increases demand for ore must remain small. Prices are nominal, with best Bilbao rubio held for about 15s. per ton c.i.f.

Antimony.—The continued lack of demand has reacted on prices, Chinese regulus for forward shipment now being obtainable at around £23 to £23 5s. c.i.f. Spot stands at about £27 to £27 10s. ex warehouse, English regulus being upheld at £37 10s. to £42 10s. per ton.

Arsenic.—The market is quietly steady at about £20 to £20 5s. c.i.f. for Mexican and Continental and £20 to £20 10s. f.o.r. mines for 99% Cornish white.

Bismuth.—Leading interests continue to quote 5s. per lb. for 5 cwt. lots.

Cadmium.—Rather dull conditions have ruled in this market and prices now stand at about 1s. 7d. to 1s. 7½d. per lb.

Cobalt Metal.—Demand is slow, but prices are unaltered at 7s. per lb.

Cobalt Oxides.—There is not a great deal of business passing, but prices are fairly steady at between 4s. 9d. and 5s. 2d. per lb. for black and 5s. 4d. and 5s. 7d. for grey.

Chromium.—About 2s. 9d. per lb. delivered continues to be quoted for metal.

Tantalum.—This has been placed on the Free List of the Tariff Act, prices standing at around £15 per lb.

Platinum.—Demand, generally speaking, has been very poor and prices have been reduced to £8 10s. per oz. for refined metal.

Palladium.—About £4 to £4 10s. per oz. is named.

Osmium.—Quotations are unchanged at £11 10s. to £12 10s. per oz.

Iridium.—In the absence of demand prices have been reduced to about £9 10s. per oz. for sponge and powder.

Tellurium.—Quotations are quite nominal at about 20s. per lb.

Selenium.—High-grade metal is well maintained at 7s. 8d. to 7s. 9d. per lb. (gold) ex warehouse.

Manganese Ore.—Demand has been at a standstill during the closing weeks of 1932. Prices are nominally unchanged at about 9½d. per unit c.i.f. for best Indian, 8½d. to 8¾d. for good 48% Indian, and 8½d. to 9d. c.i.f. for washed Caucasian.

Aluminium.—Business has not been at all brisk, but prices are fully upheld at £100 less 2% delivered for ingots and bars. It is rumoured the price may be increased.

Sulphate of Copper.—English makers are quoting about £16 10s. to £17 per ton, less 5%.

Nickel.—Prices have been reduced owing to the firmer tendency of sterling, current quotations being £250 to £255 per ton, according to quantity.

Chrome Ore.—Very slow conditions have prevailed in this market, but prices are without change at about 80s. to 85s. per ton c.i.f. for good 48% Rhodesian and 100s. to 105s. c.i.f. for 55 to 57% New Caledonian.

Quicksilver.—Leading interests here have maintained quotations at 36 dollars per flask, net, for spot metal. Demand has continued slow.

Tungsten Ore.—Hardly any buying has been witnessed during the past month and prices now stand at about 10s. 3d. to 10s. 6d. per unit c.i.f. for forward shipment from China.

Molybdenum Ore.—With supplies none too plentiful quotations are firm at 50s. per unit c.i.f. for 85% concentrates.

Graphite.—Nothing of importance has developed and quotations remain rather nominal at about £17 to £19 c.i.f. for 85 to 90% Madagascar flake and £16 to £18 c.i.f. for high-grade Ceylon lumps.

Silver.—In the first half of December the market was quiet, India and America being inclined to sell, with only limited purchases by China. Spot bars after being quoted at 17 9/16d. on December 1, fell to 17 1/16d. on December 15. Later, with a firmer tendency in sterling, no demand from China and some liquidation from "stale bulls," quotations fell to the lowest level of the year on December 29 at 16⅜d., but closed on December 31 at 16½d.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
December, 1931	877,178	46,175	923,353
January, 1932	890,688	46,096	936,784
February	869,711	44,301	914,012
March	914,017	46,018	960,035
April	901,894	47,902	949,796
May	919,223	46,421	965,644
June	913,297	45,714	959,011
July	933,947	47,213	981,160
August	943,174	48,148	991,322
September	912,870	48,631	961,501
October	926,686	48,279	974,965
November	930,085	48,631	978,716
December	931,749	48,869	980,618

TRANSVAAL GOLD OUTPUTS.

	November.		December.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	113,000	£163,603	112,500	£163,772
City Deep	80,000	21,176	80,000	21,504
Cons. Main Reef	70,500	24,374	70,200	24,492
Crown Mines	279,000	90,016	279,000	91,023
Daggafontein	46,600	£78,203	46,800	£80,707
D'rb'n Roodepoort Deep	50,200	15,475	50,000	15,585
East Geduld	62,800	20,475	63,300	20,767
East Rand P.M.	159,000	41,666	159,000	41,954
Geduld	84,000	27,157	85,000	27,541
Geldenhuis Deep	75,200	17,076	70,500	16,869
Glynn's Lydenburg	7,100	2,703	7,600	2,745
Government G.M. Areas	208,000	£403,184	214,000	£406,591
Kleinfontein	51,[illegible]00	£42,287	52,000	£45,678
Langlaagte Estate	79,000	£103,361	79,000	£105,121
Luipaard's Vlei	33,400	£35,444	33,300	8,320
Modderfontein New	172,000	62,363	178,000	62,732
Modderfontein B	75,500	20,855	75,000	20,273
Modderfontein Deep	44,500	21,167	44,900	20,820
Modderfontein East	76,000	22,241	76,000	22,088
New State Areas	90,000	£185,103	90,000	£187,843
Nourse	71,000	20,910	71,000	21,078
Randfontein	240,000	£292,002	246,000	£309,848
Robinson Deep	98,000	27,985	96,000	28,054
Rose Deep	61,250	12,697	62,000	13,050
Simmer and Jack	76,600	21,879	77,800	22,383
Springs	80,000	£162,775	80,000	£163,210
Sub Nigel	36,700	33,258	37,800	33,963
Transvaal G.M. Estates	18,500	5,690	19,300	5,645
Van Ryn	50,000	£46,646	50,500	£48,258
Van Ryn Deep	71,000	£92,729	71,000	£93,742
West Rand Consolidated	94,000	£104,743	96,500	£107,328
West Springs	79,500	£80,464	80,600	£80,734
Witw'tersr'nd (Knights)	70,000	£56,435	72,000	£57,189
Witwatersrand Deep	45,400	£47,922	45,400	£46,661

Values in S.A. currency.

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.	£
Sept'ber, 1931	2,765,400	27 10	19 5	8 5	1,162,355
October	2,870,800	27 8	19 3	8 5	1,210,743
November	2,726,720	27 10	19 5	8 5	1,144,208
December	2,793,900	27 10	19 5	8 5	1,173,732
January, 1932	2,880,500	27 5	19 4	8 1	1,163,434
February	2,775,400	27 8	19 6	8 2	1,133,212
March	2,901,300	27 10	19 7	8 3	1,200,278
April	2,883,500	27 9	19 5	8 4	1,196,011
May	2,964,100	27 6	19 2	8 4	1,228,198
June	2,927,200	27 9	19 3	8 6	1,241,392
July	2,993,600	27 5	19 0	8 5	1,260,744
August	3,027,700	27 6	19 1	8 5	1,277,923
September	2,94[illegible],800	27 6	19 1	8 5	1,234,584
October	2,994,500	27 5	19 0	8 5	1,26[illegible],274
November	2,949,050	27 8	19 2	8 6	1,256,717

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
December 31, 1931	211,552	12,260	1,402	225,214
January 31, 1932	215,752	12,394	1,598	229,744
February 29	216,171	12,177	1,363	229,711
March 31	214,024	12,009	—	226,033
April 30	214,334	11,943	—	226,277
May 31	215,926	11,972	—	227,898
June 30	217,077	11,833	—	228,910
July 31	217,525	12,056	—	229,581
August 31	217,658	11,727	—	229,385
September 30	216,398	11,642	—	228,040
October 31	216,298	11,353	—	227,651
November 30	219,024	11,207	—	230,231
December 31	221,008	11,310	—	232,318

PRODUCTION OF GOLD IN RHODESIA.

	1929	1930	1931	1932
	oz.	oz.	oz.	oz.
January	46,231	46,121	45,677	42,706
February	44,551	43,385	42,818	45,032
March	47,388	45,511	42,278	47,239
April	48,210	45,806	43,776	46,487
May	48,189	47,645	43,731	46,854
June	48,406	45,208	44,118	48,441
July	46,369	45,810	44,765	47,331
August	46,473	46,152	43,292	49,254
September	45,025	46,151	42,846	50,198
October	46,923	45,006	44,260	50,416
November	46,219	44,351	44,516	48,082
December	46,829	46,485	50,034	—

RHODESIAN GOLD OUTPUTS.

	November.		December.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	25,600	9,598	25,600	10,497
Globe and Phœnix	6,038	5,813	6,074	6,012
Lonely Reef	9,500	2,225	10,000	2,219
Luiri Gold	—	—	—	—
Rezende	6,500	2,546	6,500	2,546
Sherwood Star	4,800	£6,315	5,200	£6,800
Wanderer Consolidated	15,300	3,512	16,100	3,591

WEST AFRICAN GOLD OUTPUTS.

	November.		December.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	7,623	£23,932	7,291	£21,621
Ashanti Goldfields	13,210	14,724	13,452	14,782
Taquah and Abosso	10,132	3,177	10,259	3,272

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.
	Oz.	Oz.	Oz.
December, 1931	49,215	4,700	1,224
January, 1932	44,037	—	916
February	44,672	—	981
March	47,108	9,735†	769
April	48,936	3,912	1,216
May	53,928	2,782	692
June	50,079	—	920
July	53,585	2,530	1,391
August	51,536	—	1,026
September	54,427	—	1,160
October	51,236	—	—
November	53,956	—	—
December	52,282	—	—

† Jan., Feb., and March.

AUSTRALASIAN GOLD OUTPUTS.

	November.		December.	
	Tons.	Value £	Tons.	Value £
Associated G.M. (W.A.)	5,331	5,746	5,423	5,724
Blackwater (N.Z.)	3,750	2,061	2,860	1,408*
Boulder Persev'ce (W.A.)	7,073	13,728	3,940	8,001
Grt. Boulder Pro. (W.A.)	7,403	5,186*	—	—
Lake View & Star (W.A.)	30,389	40,461	31,022	33,635
Sons of Gwalia (W.A.)	12,258	15,523	12,132	15,419
South Kalgurli (W.A.)	—	—	9,928	15,946
Waihi (N.Z.)	—	{ — —	26,647	{ 8,292* 61,101†
Wiluna	27,188	7,235*	—	—

* Oz. gold. † Oz. silver.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA

	November.		December.	
	Tons Ore.	Total Oz.	Tons Ore.	Total Oz.
Champion Reef	9,100	5,674	9,520	5,708
Mysore	14,400	7,470	14,908	7,885
Nundydroog	18,330	9,610*	19,608	10,383†
Ooregum	11,553	4,134	11,312	4,153

* 1,764 oz. from 1,553 tons Balaghat ore. † 2,378 oz. from 1,848 tons Balaghat ore.

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	November.		December.	
	Tons.	Value £	Tons.	Value £
Bulolo Gold	—	122,620*d*†	—	114,696*d*
Chosen Corp. (Korea)	9,680	15,431	9,940	17,337
Frontino Gold (C'lbia)	3,320	16,580	3,548	15,986
Fresnillo	80,559	2,906*d*‡	—	—
New Goldfields of Venezuela	9,644	2,070*	9,440	2,265*
Oriental Cons. (Korea)	—	71,125*d*	—	106,320*d*
St. John del Rey (Brazil)	—	35,000	—	38,000
Santa Gertrudis (Mexico)	20,558	1,297*d*	—	—
Viborita	—	—	—	—
West Mexican Mines	1,260	23,900*d*	—	—

d Dollars. * Oz. gold. † To Dec. 3. ‡ Loss.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

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

January, 1932	3,014	July, 1932	1,437
February	2,132	August	1,164
March	3,064	September	1,123
April	3,333	October	2,273
May	2,276	November	2,242
June	2,491	December	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	Oct.	Nov.	Dec.
Ayer Hitam	107¼	—	—
Batu Caves	—	—	—
Changkat	40	60	60
Gopeng	—	—	72½*
Hongkong Tin	29¾	65¼	—
Idris Hydraulic	17¾	18¼	—
Ipoh	87½	67¾	—
Kampar Malaya	—	—	—
Kampong Lanjut	—	—	—
Kamunting	156	125	146
Kent (F.M.S.)	—	—	—
Killinghall	52¼	35	—
Kinta	—	—	34*
Kinta Kellas	—	—	—
Kramat Tin	35	25	85
Kuala Kampar	—	27	50
Kundang	—	—	—
Lahat	16	12	4½
Lower Perak	—	—	—
Malaya Consolidated	—	—	—
Malayan Tin	59½	59¼	40¼
Malim Nawar	10	—	—
Pahang	78	78	78
Penawat	73¼	—	—
Pengkalen	—	—	67*
Petaling	222	48	2*
Rahman	—	—	—
Rambutan	—	—	—
Rantau	—	—	—
Rawang	30	33	37
Rawang Concessions	16	25	46
Renong	18¾	47	17½
Selayang	12½	—	—
Southern Kampar	94	62½	—
Southern Malayan	50½	59½	48
Southern Perak	57¼	—	—
Southern Tronoh	17½	18	18
Sungei Besi	—	—	—
Sungei Kinta	—	—	—
Sungei Way	35¾	31½	35¾
Taiping	—	—	—
Tanjong	—	—	—
Tekka	—	—	39*
Tekka Taiping	—	—	65*
Temoh	—	—	—
Tronoh	38½	39	39
Ulu Klang	—	—	—

* 3 months to Dec. 31.

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Oct.	Nov.	Dec.
Anglo-Nigerian	14¼	12¼	13
Associated Tin Mines	109½	106½	107½
Baba River	1	1	3
Batura Monguna	—	—	—
Bisichi	16	16	—
Dafo	—	—	—
Ex-Lands	26	27	16½
Filani	—	—	—
Jantar	12	10	9
Jos	7¾	7¾	—
Juga Valley	5½	5½	5½
Kaduna Syndicate	12¼	12	11¼
Kaduna Prospectors	6	6	5†
Kassa	5	6	4½
London Tin	77	74	73
Lower Bisichi	4	2	—
Naraguta Extended	—	—	—
Nigerian Consolidated	4	4½	—
Offin River	—	—	—
Ribon Valley	11½	11½	11½
Tin Fields	—	—	—
United Tin Areas	10½	11	10
Yarde Kerri	—	—	—

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Oct.	Nov.	Dec.
Anglo-Burma (Burma)	45	50⅝	—
Aramayo Mines (Bolivia)	123	124	—
Bangrin (Siam)	77½	68½	70½
Beralt	—	25*	—
Consolidated Tin Mines (Burma)	116	90	79
East Pool (Cornwall)	43¾	48¼	—
Fabulosa (Bolivia)	41	36	36
Kagera (Uganda)	25	42	—
Kamra	—	—	—
Malaysiam Tin	14¼	14¼	14¼
Mawchi	188*	213*	220*
Patino	—	—	—
Pattani	—	—	—
San Finx (Spain)	—	—	—
Siamese Tin (Siam)	164¾	56¼	106¼
South Crofty	54	56¼	55¾
Tavoy Tin (Burma)	52½	61	84¼
Tongkah Harbour (Siam)	36	34	26
Toyo (Japan)	54	54¼	68½
Zaaiplaats	15	—	—

* Tin and Wolfram.

COPPER LEAD, AND ZINC OUTPUTS.

		Nov.	Dec.
Britannia Lead	Tons refined lead	3,255	—
	Oz. refined silver	131,748	—
Broken Hill South	Tons lead conc.	5,732	5,832
	Tons zinc conc.	6,233	6,019
Burma Corporation	Tons refined lead	5,880	5,880
	Oz. refined silver	509,982	508,769
Electrolytic Zinc	Tons zinc	—	—
Indian Copper	Tons copper	400	350
	Tons yellow metal	503	520
Messina	Tons copper	869	790
Mount Isa	Tons lead bullion	5,250	—
Mount Lyell	Tons concentrates	3,227	2,655
North Broken Hill	Tons lead conc.	4,440†	—
	Tons zinc conc.	4,500†	—
Rhodesia Broken Hill	Tons V_2O_5	30	20
	Tons V_2O_5 conc.	100	100
Roan Antelope	Tons blister copper	3,200	3,002
Sulphide Corporation	Tons lead conc.	1,050	—
	Tons zinc conc.	2,387	—
Trepca	Tons lead conc.	5,061	4,971
	Tons zinc conc.	7,513	7,170
Zinc Corporation	Tons lead conc.	5,814	5,809
	Tons zinc conc.	4,713	4,757

† To Nov. 19.

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

		Oct.	Nov.
Iron Ore	Tons	167,537	159,737
Manganese Ore	Tons	2,763	3,628
Iron and Steel	Tons	163,190	57,892
Copper and Iron Pyrites	Tons	12,586	13,693
Copper Ore, Matte, and Prec.	Tons	1,598	2,314
Copper Metal	Tons	21,630	18,852
Tin Concentrate	Tons	2,951	2,329
Tin Metal	Tons	190	196
Lead Pig and Sheet	Tons	25,003	28,730
Zinc (Spelter)	Tons	3,872	4,749
Zinc Sheets, etc.	Tons	1,553	1,722
Zinc Oxide	Tons	30	39
Zinc Ore	Tons	24,376	28,151
Aluminium	Tons	259	1,324
Mercury	Lb.	158,694	119,363
White Lead	Cwt.	3,020	5,543
Barytes, ground	Cwt.	22,859	23,914
Asbestos	Tons	1,344	1,389
Boron Minerals	Tons	795	1,119
Borax	Cwt.	9,180	6,280
Basic Slag	Tons	1.000	—
Superphosphates	Tons	1,001	2,191
Phosphate of Lime	Tons	25,459	15,250
Mica	Tons	173	132
Tungsten Ores	Tons	357	192
Sulphur	Tons	2,746	4,831
Nitrate of Soda	Cwt.	—	—
Potash Salts	Cwt.	490,800	119,984
Petroleum: Crude	Gallons	27,856,461	21,653,730
Lamp Oil	Gallons	10,522,413	13,039,661
Motor Spirit	Gallons	84,868,036	62,484,205
Lubricating Oil	Gallons	5,190,126	4,587,309
Gas Oil	Gallons	9,400,980	3,705,314
Fuel Oil	Gallons	40,779,091	29,426,173
Asphalt and Bitumen	Tons	5,806	4,026
Paraffin Wax	Cwt.	96.157	101,880

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES.

In Tons.

	Oct.	Nov.	Dec.
Anglo-Ecuadorian	16,021	15,465	16,007
Apex Trinidad	50,750	44,970	43,020
Attock	1,523	1,622	1,669
British Burmah	3,724	3,443	3,789
British Controlled	38,691	37,575	—
Kern Mex	836	794	847
Kern River (Cal.)	2,891	3,000	3,292
Kern Romana	92	87	84
Kern Trinidad	1,810	1,549	1,561
Lobitos	24,803	23,700	24,287
Phœnix	106,949	86,333	78,406
St. Helen's Petroleum	4,127	4,130	4,218
Steaua Romana	114,295	103,664	—
Tampico	2,352	2,201	—
Tocuyo	1,221	1,255	1,186
Trinidad Leaseholds	28,000	27,450	29,950

QUOTATIONS OF OIL COMPANIES' SHARES.

Denomination of Shares £1 unless otherwise noted.

	Dec. 10, 1932.			Jan. 10, 1933.		
	£	s.	d.	£	s.	d.
Anglo-Ecuadorian		12	9		12	9
Anglo-Egyptian B	1	12	0	1	11	3
Anglo-Persian 1st Pref.	1	4	3	1	5	9
,, ,, Ord.	1	13	9	1	16	3
Apex Trinidad (5s.)	1	0	9	1	0	3
Attock		10	0		10	6
British Burmah (8s.)		3	6		3	0
British Controlled ($5)		3	6		4	0
Burmah Oil	3	0	0	3	0	6
Kern River Cal. (10s.)		2	3		2	6
Lobitos, Peru	1	16	3	1	16	3
Mexican Eagle, Ord. (4 pesos)		7	3		7	9
,, ,, 8% Pref. (4 pesos)		6	9		7	3
Phœnix, Roumanian		11	0		11	6
Royal Dutch (100 fl.)	18	2	6	19	0	0
Shell Transport, Ord.	2	7	6	2	9	3
,, ,, 5% Pref. (£10)	11	0	0	10	17	6
Steaua Romana		9	0		8	9
Trinidad Leaseholds	2	11	3	2	11	3
United British of Trinidad (6s. 8d.)		4	3		5	0
V.O.C. Holding	1	11	9	1	11	9

PRICES OF CHEMICALS. Jan. 10.

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

		£	s.	d.
Acetic Acid, 40%	per cwt.	1	0	9
,, ,, 80%	,,	1	18	5
,, ,, Glacial	per ton	59	0	0
Alum	,,	8	7	6
Aluminium Sulphate, 17 to 18%	,,	6	15	0
Ammonium, Anhydrous	per lb.		1	1
,, 0·880 solution	per ton	15	10	0
,, Carbonate	,,	27	10	0
,, Nitrate (British)	,,	16	0	0
,, Phosphate, comml.	,,	40	0	0
,, Sulphate, 20·6% N.	,,	6	5	0
Antimony, Tartar Emetic, 43/44%	per lb.			10
,, Sulphide, golden	,,			9
Arsenic, White (foreign)	per ton	20	0	0
Barium, Carbonate (native), 94%	,,	4	10	0
,, Chloride	,,	10	10	0
Barytes	,,	8	5	0
Benzol, standard motor	per gal.		1	6½
Bleaching Powder, 35% Cl.	per ton	8	15	0
Borax	,,	16	10	0
Boric Acid	,,	26	10	0
Calcium Chloride, solid, 70/75%	,,	5	15	0
Carbolic Acid, crude 60's	per gal.		2	1
,, ,, crystallized, 40°	per lb.			8½
Carbon Disulphide	per ton	30	0	0
Citric Acid	per lb.			10
Copper Sulphate	per ton	15	10	0
Creosote Oil (f.o.b. in Bulk)	per gal.			4¾
Cresylic Acid, 98-100%	,,		1	3
Hydrofluoric Acid, 59/60%	per lb.			6
Iodine Resub. B.P. (28 lb. lots)	,,		15	10
Iron, Nitrate 80° Tw.	per ton	6	0	0
,, Sulphate	,,	1	15	0
Lead, Acetate, white	,,	32	10	0
,, Nitrate (ton lots)	,,	27	10	0
,, Oxide, Litharge	,,	25	10	0
,, White	,,	37	10	0
Lime, Acetate, brown	,,	9	0	0
,, ,, grey, 80%	,,	12	10	0
Magnesite, Calcined	,,	8	5	0
Magnesium Chloride	,,	6	10	0
,, Sulphate, comml.	,,	4	10	0
Methylated Spirit Industrial 61 O.P.	per gal.		2	0
Nitric Acid, 80° Tw.	per ton	19	0	0
Oxalic Acid	per ton	50	10	0
Phosphoric Acid. (Conc. 1·750)	per lb.			10
Pine Oil	per cwt.	2	7	6
Potassium Bichromate	per lb.			5
,, Carbonate, 96/98%	per ton	32	0	0
,, Chlorate	per lb.			4
,, Chloride, 80%	per ton	9	10	0
,, Ethyl Xanthate	per 100 kilos	7	0	0
,, Hydrate (Caustic) 88/90%	per ton	40	0	0
,, Nitrate	,,	30	0	0
,, Permanganate	per lb.			8½
,, Prussiate, Yellow	,,			8
,, ,, Red	,,		2	0
,, Sulphate, 90%	per ton	10	10	0
Sodium Acetate	,,	22	0	0
,, Arsenate, 45%	,,	23	0	0
,, Bicarbonate	,,	10	10	0
,, Bichromate	per lb.			4
,, Carbonate (Soda Ash), 58%	per ton	6	0	0
,, ,, (Crystals)	,,	5	5	0
,, Chlorate	,,	28	10	0
,, Cyanide, 100% NaCN basis	per lb.			8
,, Ethyl Xanthate	per 100 kilos	6	12	6
,, Hydrate, 76%	per ton	14	0	0
,, Hyposulphite, comml.	,,	9	2	6
,, Nitrate (refined)	,,	8	10	0
,, Phosphate, comml.	,,	12	0	0
,, Prussiate	per lb.			5
,, Silicate	per ton	9	10	0
,, ,, (liquid, 140° Tw.)	,,	8	10	0
,, Sulphate (Glauber's Salt)	,,	2	15	0
,, ,, (Salt-Cake)	,,	3	1	0
,, Sulphide, Conc., 60/65%	,,	10	15	0
,, Sulphite, pure	per cwt.		14	0
Sulphur, Flowers	per ton	10	15	0
,, Roll	,,	11	0	0
Sulphuric Acid 168° Tw.	,,	4	5	0
,, ,, free from Arsenic, 140° Tw.	,,	3	0	0
Superphosphate of Lime (S.P.A. 16%)	,,	3	4	0
Tartaric Acid	per lb.			10½
Turpentine	per ton	63	15	0
Tin Crystals	per lb		1	0
Titanous Chloride	,,			10¾
Zinc Chloride	per ton	9	10	0
,, Dust, 90/92%	,,	20	0	0
,, Oxide (White Seal)	,,	35	0	0
,, Sulphate	,,	9	0	0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

GOLD AND SILVER:

	Dec. 10, 1932. £ s. d.	Jan. 10, 1933. £ s. d.
SOUTH AFRICA:		
Brakpan	4 10 0	4 8 9
City Deep	12 0	15 3
Consolidated Main Reef	1 11 3	1 15 0
Crown Mines (10s.)	6 13 9	6 17 6
Daggafontein	3 5 0	3 0 0
Durban Roodepoort Deep (10s.)	1 1 3	1 5 6
East Geduld	4 6 9	3 18 9
East Rand Proprietary (10s.)	13 0	1 0 9
Geduld	5 8 0	4 18 9
Geldenhuis Deep	11 6	17 6
Glynn's Lydenburg	—	14 6
Government Gold Mining Areas (5s.)	1 18 0	1 14 3
Grootvlei	1 13 0	1 11 3
Langlaagte Estate	1 2 3	1 4 3
Luipaard's Vlei (2s.)	5 6	7 0
Modderfontein, New (10s.)	2 10 6	2 8 9
Modderfontein B (5s.)	13 3	14 6
Modderfontein Deep (5s.)	18 9	16 6
Modderfontein East	2 7 6	2 7 6
New Kleinfontein	1 2 0	1 5 9
New State Areas	3 4 3	2 13 9
Nourse	18 3	1 7 6
Randfontein	2 3 9	2 5 3
Robinson Deep A (1s.)	16 9	13 9
" " B (7s. 6d.)	14 0	1 1 3
Rose Deep	7 3	14 9
Simmer and Jack (2s. 6d.)	4 0	6 3
Springs	4 16 9	4 2 6
Sub Nigel (10s.)	6 0 6	5 8 9
Van Ryn	14 3	18 0
Van Ryn Deep	1 1 9	1 3 9
Village Deep (9s. 6d.)	1 6	1 6
West Rand Consolidated (10s.)	17 9	18 9
West Springs	1 6 6	1 8 0
Witwatersrand (Knights)	9 0	16 9
Witwatersrand Deep	11 6	16 3
RHODESIA:		
Cam and Motor	2 10 0	2 3 9
Globe and Phœnix (5s.)	18 0	18 6
Lonely Reef	12 6	11 3
Luiri Gold (5s.)	1 9	1 0
Rezende (17s. 6d.)	1 12 6	1 10 0
Sherwood Starr (5s.)	13 9	12 9
Wanderer	17 6	16 9
GOLD COAST:		
Ariston (2s. 6d.)	7 6	8 0
Ashanti (4s.)	1 19 9	2 0 9
Taquah and Abosso (4s.)	9 9	10 0
AUSTRALASIA:		
Associated Gold (4s.), W.A.	3 9	3 3
Golden Horseshoe (8s.), W.A.	4 0	4 0
Great Boulder Propriet'y (2s.), W.A.	7 6	7 0
Lake View and Star (4s.), W.A.	19 9	1 0 0
Sons of Gwalia (10s.), W.A.	14 9	14 9
South Kalgurli (10s.), W.A.	1 2 0	1 0 9
Waihi (5s.), N.Z.	17 9	17 9
Wiluna Gold, W.A.	2 1 9	2 1 9
INDIA:		
Champion Reef (10s.)	1 0 6	1 2 0
Mysore (10s.)	12 9	12 0
Nundydroog (10s.)	2 1 9	2 3 6
Ooregum (10s.)	5 9	5 9
AMERICA:		
Camp Bird (2s.), Colorado	3	2
Exploration (10s.)	2 6	2 0
Frontino and Bolivia, Colombia	1 6 3	1 2 6
Mexican Corporation (10s.), Mexico	3 6	4 0
New Goldfields of Venezuela (5s.)	4 9	4 9
St. John del Rey, Brazil	1 3 6	1 3 0
Santa Gertrudis, Mexico	4 6	5 6
Viborita (5s.), Colombia	4 4	4 3
MISCELLANEOUS:		
Chosen, Korea	8 0	8 6
New Guinea	4 6	4 3

COPPER:

	Dec. 10, 1932.	Jan. 10, 1933.
Bwana M'Kubwa (5s.), Rhodesia	3 3	3 6
Esperanza Copper, Spain	—	—
Indian (2s.)	1 6	1 3
Loangwa (5s.), Rhodesia	1 6	1 6
Messina (5s.), Transvaal	4 6	6 0
Mount Lyell, Tasmania	17 0	16 9
Namaqua (£2), Cape Province	2 2	—
Rhodesia Katanga	10 0	10 0
Rio Tinto (£5), Spain	16 10 0	18 2 6
Roan Antelope (5s.), Rhodesia	10 6	12 3
Tanganyika Concessions	17 6	19 3
Tharsis (£2), Spain	3 1 3	3 10 0

LEAD-ZINC:

	Dec. 10, 1932. £ s. d.	Jan. 10, 1933. £ s. d.
Amalgamated Zinc (8s.), N.S.W.	6 3	7 6
Broken Hill Proprietary, N.S.W.	19 9	1 1 0
Broken Hill, North. N.S.W.	2 15 0	2 13 9
Broken Hill, South, N.S.W.	1 16 3	1 17 6
Burma Corporation (10 rupees)	10 0	10 6
Electrolytic Zinc Pref., Tasmania	12 3	11 3
Mount Isa, Queensland	9 0	8 0
Rhodesia Broken Hill (5s.)	1 6	1 9
San Francisco (10s.), Mexico	7 3	7 9
Sulphide Corporation (15s.), N.S.W.	5 9	6 0
ditto, Pref.	8 3	7 9
Trepca (5s.), Yugoslavia	8 6	7 9
Zinc Corporation (10s.), N.S.W.	1 1 3	1 2 6
ditto, Pref.	3 7 6	3 7 6

TIN:

	Dec. 10, 1932.	Jan. 10, 1933.
Aramayo Mines (25 fr.), Bolivia	12 6	10 0
Associated Tin (5s.), Nigeria	4 3	4 0
Ayer Hitam (5s.), Malay	11 0	11 0
Bangrin, Siam	11 6	11 9
Bisichi (10s.), Nigeria	5 3	5 3
Consolidated Tin Mines of Burma	3 0	2 9
East Pool (5s.), Cornwall	9	9
Ex-Lands Nigeria (2s.)	1 3	—
Geevor (10s.), Cornwall	2 9	—
Gopeng, Malay	1 6 3	1 6 3
Hongkong (5s.), Malay	13 6	12 9
Idris (5s.), Malay	4 3	4 3
Ipoh Dredging (16s.), Malay	13 0	12 9
Kaduna Prospectors (5s.), Nigeria	5 0	5 0
Kaduna Syndicate (5s.), Nigeria	12 6	12 6
Kamunting (5s.), Malay	5 4	5 9
Kepong, Malay	7 6	6 3
Kinta (5s.), Malay	4 0	4 0
Kinta Kellas (5s.), Malay	3 6	3 6
Kramat Pulai, Malay	14 6	14 6
Kramat Tin, Malay	1 6 0	1 6 0
Lahat, Malay	5 0	—
Malayan Tin Dredging (5s.)	15 9	15 9
Naraguta, Nigeria	8 9	8 9
Pahang Consolidated (5s.), Malay	4 6	4 3
Penawat ($1), Malay	1 1	—
Pengkalen (5s.), Malay	8 0	8 3
Petaling (2s. 4d.), Malay	10 0	10 0
Rambutan, Malay	4 6	4 6
Renong Dredging, Malay	15 6	15 6
Siamese Tin (5s.), Siam	7 0	6 6
South Crofty (5s.), Cornwall	2 0	2 0
Southern Malayan (5s.)	9 6	9 9
Southern Perak, Malay	1 5 0	1 5 0
Southern Tronoh (5s.), Malay	5 0	4 3
Sungei Besi (5s.), Malay	7 0	8 9
Sungei Kinta, Malay	10 0	10 0
Tanjong (5s.), Malay	7 0	6 6
Tavoy (4s.), Burma	4 3	4 6
Tekka, Malay	10 0	10 0
Tekka Taiping, Malay	10 0	8 9
Tem h, Malay	10 0	8 9
Toyo (2s. 6d.), Japan	2 6	2 6
Tronoh (5s.), Malay	13 6	13 9

DIAMONDS:

	Dec. 10, 1932.	Jan. 10, 1933.
Consol. African Selection Trust (5s.)	15 0	17 6
Consolidated of S.W.A. (10s.)	3 9	3 9
De Beers Deferred (£2 10s.)	4 13 9	5 3 9
Jagersfontein	1 3 9	1 6 3
Premier Preferred (5s.)	1 5 0	1 5 0

FINANCE, Etc.:

	Dec. 10, 1932.	Jan. 10, 1933.
Anglo American Corporation (10s.)	11 0	11 3
Anglo-Continental (10s.)	4 0	4 0
Anglo-French Exploration	14 3	15 0
Anglo-Oriental (5s.)	6 0	6 0
ditto, Pref.	9 6	8 9
British South Africa (15s.)	15 6	17 3
Central Mining (£8)	12 2 6	13 0 0
Consolidated Gold Fields	2 0 6	1 17 6
Consolidated Mines Selection (10s.)	7 9	8 3
Fanti Consols (8s.)	8 3	8 0
General Mining and Finance	1 4 6	1 10 0
Gold Fields Rhodesian (10s.)	4 0	4 0
Johannesburg Consolidated	1 11 6	1 15 3
London Tin Corporation (10s.)	8 9	9 0
Minerals Separation	3 1 3	3 2 6
Mining Trust	4 0	4 0
National Mining (8s.)	6	—
Rand Mines (5s.)	4 3 0	4 10 0
Rand Selection (5s.)	11 6	12 3
Rhodesian Anglo American (10s.)	9 0	9 0
Rhodesian Selection Trust (5s.)	4 0	4 9
Rhokana Corp.	4 0 0	4 5 0
Tigon (5s.)	2 9	—
Union Corporation (12s. 6d.)	3 4 3	3 6 3
Venture Trust (6s. 8d.)	5 9	6 3

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

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

AIR-COMPRESSOR TESTING

The 1932 edition of "Compressed Air Terms and Standards," issued by the British Compressed Air Society, contains an account of a standard nozzle method of determining the efficiency of an air compressor that has been adopted by the Society from the report of the Heat Engines Trials Standing Committee on Air-flow Measurement to the Institution of Civil Engineers. In view of the article by Mr. H. G. Smith that appeared in the November and December issues of the MAGAZINE it seems well worth while to reproduce particulars of this test here, particularly as reference is made to it elsewhere in this issue.

The report covers tests to find the free air delivered (F.A.D.) of a compressor under its specified working conditions and states that the nozzle test can be used for all compressors or exhausters, calling for only nine sizes of nozzle, together with their up-stream and down-stream pipes for volumes from 6 cu. ft. to 30,000 cu. ft. per minute. It is hoped, the report states, that the nozzle test will be the standard adopted by all manufacturers of air-compressors and exhausters, as well as by all users of compressed air. The test is convenient and extremely accurate. It only depends upon three test observations, all of which can be taken with a very small percentage of error.

The following symbols are used in the report :—

Q = quantity discharged per unit of time, lb./sec.

h = observed head, inches of water.

T = absolute temperature = observed temperature ($t°$ $F.$) + 459·6.

m_2 = absolute pressure, downstream side, inches of mercury. (Obtainable by adding or substracting from the atmosphere pressure as given by the barometer the appropriate water gauge reading, or readings, obtained from the manometer. To bring water gauge readings to inches of mercury divide by 13·6.)

d_1 = diameter of pipe, upstream, inches.

d_2 = diameter of nozzle, downstream, inches.

$n = (d_1/d_2)^2$.

M = coefficient for velocity of approach = $n/\sqrt{(n_2 - 1)} = 1 + \frac{1}{2n^2}$ approximately for n greater than 4·5.

δ = compressibility factor.

α = coefficient of discharge of nozzle.

Δ = specific gravity of gas relative to dry air at the same temperature and pressure.

Air-compressors, blowers, and fans may be tested by discharging the air to the atmosphere through a nozzle or by passing the air through a nozzle in a pipe line. Exhausters may also be similarly tested with the nozzle on the intake side. The nozzle to be used is the I.G. (Interessen Gesellschaft) type nozzle (Figs. 1 and 2), and is to be made of bronze, cast and machined truly parallel in the throat. The thickness of the metal is to be sufficient to prevent deformation during use either from working pressures or otherwise. The diameter of a nozzle is that of its throat or down-stream side (d_2) and all other dimensions are fixed in terms of this diameter. Nozzles of any size can therefore be constructed from Figs. 1 and 2, which also show the pressure-ring connexions through which the pressures are to be measured.

The drop in pressure (h) between the up-stream and down-stream sides of the nozzle is to be measured by a double-leg manometer. In order to obtain m_2 the difference in pressure between the down-stream side of the nozzle and the barometer is to be measured by a second manometer (Fig. 3). In Fig. 4 a similar measurement is to be made on the up-stream side of nozzle. The pressure pipes to the manometers are to be connected to the top or sides of the nozzle, so as to prevent moisture collecting in these pipes.

The nozzle is to be attached to the pipe system leading from the compressor, the length of straight pipe of uniform bore up-stream of the nozzle is to be not less than 20 nozzle diameters, and its diameter is to be between 2·25 and 2·5 nozzle diameters. The nozzle should be designed to suit the standard size of pipes. The approach pipe and the nozzle are to be considered as integral parts of each other.

The pipe system is to be drained so as to prevent moisture accumulating behind the nozzle, and may be laid at any angle provided that there is no obstruction to interfere with the free flow from it. The internal surface of the pipe attached to the nozzle need not be smoother than is usual in customary commercial finish and riveted pipes may be used for the larger sizes.

The nozzle is to be shielded by allowing the discharge to take place into the open air through a pipe of the same diameter as the up-stream pipe and in length not less than 10 nozzle diameters.

In all cases the temperature is to be measured on the down-stream side of the nozzle at a distance of four nozzle diameters. The thermometer pocket is to be well immersed to ensure that the temperature of the air is taken, not that of the pipe, but in large pipes, for nozzles exceeding eight inches in diameter, the immersion need not exceed one-half the nozzle diameter.

The air from the compressor is to be delivered into a receiver, from which it is to pass through a flow-control valve to the measuring nozzle. Passage through the control valve will expand the air, and it will pass through the nozzle at a pressure not greatly in excess of atmospheric pressure. By this means the pulsations of reciprocating compressors will, generally, be eliminated. In cases where these flow pulsations are not eliminated, other means, as described in the Heat Engine Trials report should be

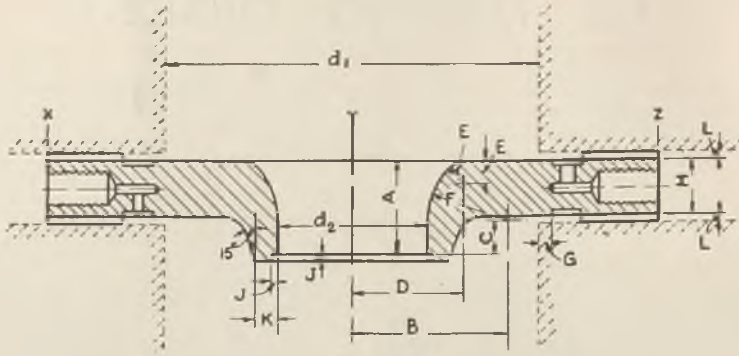
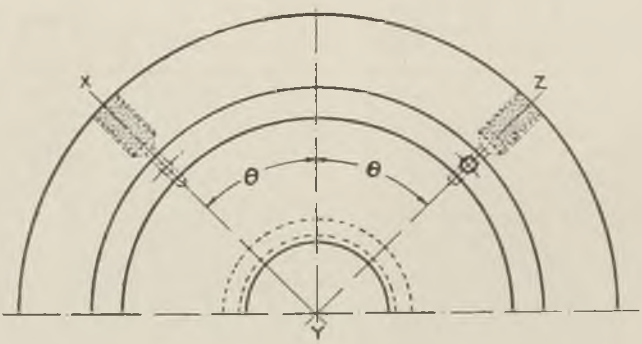


FIG. 1.



Dimensions of Standard Nozzle in terms of d_2	d_2	A	B	C	D	E	F	G	H	J	K	d_1	θ
	1	0·605	0·83	0·30	Not Required	0·20	0·33	0·05 Minimum	0·35 Maximum	0·033	0·083	2·25 to 2·50	10°–80°

L { = 1/16 for 3/8, 5/8, 1, 1½ Nozzles
L { = 1/8 for 2½ Nozzles and over

FIG. 2.

adopted. In order to eliminate the eddies caused by the flow-control valve, a honeycomb grid is to be fixed in the pipe upstream of the nozzle (Fig. 3). The pipe systems shown in Figs. 3 and 4 are typical and may be varied to suit particular cases, but arrangements that lead to eddies and swirling flow are to be avoided.

For the purpose of calculating the flow of air, the following formula is to be used :—

$$Q = 0{\cdot}1148\, M\alpha\delta \sqrt{\Delta d_2{}^2} \sqrt{h} \sqrt{(m_2/T)} \text{ lb./sec.}$$

The equivalent discharge in cubic feet per minute of air at standard temperature (60° F.) and pressure (30 in. *Hg*)

$$= 60Q/0{\cdot}0764 = 785Q$$

while the corresponding discharge at any other temperature and pressure may be obtained therefrom by the usual dry gas formula. For commercial purposes air is to be treated as a dry gas and no calculations need involve humidity. It is recommended that a table of the values of $\sqrt{(m_2/T)}$ be prepared over the usual working ranges of temperature and barometric pressure. For all nozzles used under the specified conditions, the working value of the product of the three coefficients $M\alpha\delta$ in the flow equation is to be 0·995.

Nozzles of all diameters greater than 0·5 in. are to be used over the range from $h = 0{\cdot}4$ to $h = 40$ with an overload of 25%, provided that the flow is greater than 10 cu. ft./min. The value 0·995 is subject to a tolerance of $\pm$ 1·5%.

To find an approximate value of d_2 for a working value of $h = 40$ in. of water for a given volume : $d_2 = \frac{1}{12} \times \sqrt{\text{discharge in cu. ft./min.}}$ This is then to be adjusted to suit standard diameters of pipes and nozzles or for other special conditions.

The report mentions other means of eliminating pulsations as described in Heat Engine Trials Report. The extract is as follows : If a pulsating liquid flow is being measured by a nozzle fitted in a pipe line, a damped manometer across the obstruction will read the mean of the pressure differences, whereas the flow depends upon the square root of these pressure differences. It is not usually possible to measure pulsating gaseous flows accurately by means of a nozzle, as in addition to the error described above, pressure waves travel up and down the pressure pipes and cause false readings.

To measure a compressor discharge with a nozzle, the air should be expanded through a valve to approximately atmospheric pressure before inserting the nozzle. Sufficient receiver capacity and throttling should be introduced between the source of pulsation and the measuring nozzle virtually to damp out all the pulsations.

The foregoing gives all the necessary information by which the F.A.D. of a compressor can be determined from the test, but it is convenient to have the calculations simplified as far as possible when using the formula. The flow formula in the report gives Q in fundamental units of mass and time. From this the volume can be calculated for any conditions of pressure and temperature at the down-stream side of the nozzle, or at the inlet of the compressor.

At standard temperature (60° F.) and pressure (30 in. Hg) the equivalent discharge $= 785Q = 785 \times 0{\cdot}1148 \quad M\alpha\delta\sqrt{\Delta}\,d_2^2\sqrt{h}\sqrt{m_2/T} = 89{\cdot}7 d_2^2 \sqrt{h}\sqrt{m_2/T}$ since $M\alpha\delta = 0{\cdot}995$ and $\sqrt{\Delta} = 1$ for air.

As the equivalent discharge at inlet conditions of the compressor, or, in other words, the F.A.D. is usually required, it is more convenient to calculate this directly from the test results. Let Ti = inlet temperature (absolute °F). Pi = inlet pressure (in Hg)

Pi will generally be the barometric reading at the time of the test.

$$\text{then F.A.D.} = 89{\cdot}7 \times \frac{30}{519{\cdot}6} \times Ti/Pi \times d_2^2\sqrt{h}\sqrt{m_2/T}$$
$$= (5{\cdot}18\ d_2^2) \times Ti/Pi\sqrt{h}\sqrt{m_2/T}$$
$$= K \times Ti/Pi\sqrt{h}\sqrt{m_2/T}$$

The value of K is given in the table of standard nozzles adopted by the B.C.A.S.

It will be seen that the only observations taken to find F.A.D. are :—

the inlet conditions Ti and Pi,
and the nozzle readings h, m_2 and T.

As an example of the working out of test results taken with a nozzle is as follows : Size of standard nozzle used $2\frac{1}{2}$ in. Observations made at compressor intake during test :—

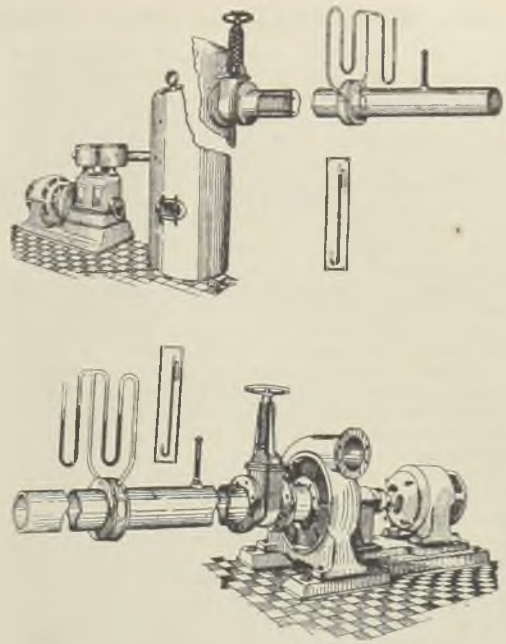
Temperature $= 65°$ F. $\therefore Ti = 65 + 459{\cdot}6 = 525°$ F.

Pressure $Pi = 30{\cdot}22$ in Hg (barometric pressure).

Observations at nozzle, average during test :—

$h = 16$ in. water gauge.
m_2 = barometer $- 0{\cdot}27$ in water gauge $= 30{\cdot}22 - 0{\cdot}27/13{\cdot}6 = 30{\cdot}2$ in Hg.
$t = 100°$ F.
$T = 100 + 459{\cdot}6 = 560°$ F.

$$\text{F.A.D.} = 32{\cdot}4 \times Ti/Pi \times \sqrt{h}\ \sqrt{m_2/T} = 32{\cdot}4 \times \frac{525}{30{\cdot}22} \times \sqrt{16}\ \sqrt{30{\cdot}2/560}$$
$$= 523 \text{ cu. ft.}$$



Figs. 3 and 4.—Pipe Systems for Nozzle.

Table I

Standard Nozzles

d_2 = diam. of Nozzle.	d_1 = diam. of Pipe.	d_1/d_2	Volume in cu. ft. per min. of Air passing at flow temp. assumed 100° F. and atmospheric pressure assmd. 30 in. Hg. $h = 4$ in.	$h = 40$ in.	K
$\frac{3}{8}$	$\frac{7}{8}$	2·33	6	18	0·73
$\frac{5}{8}$	$1\frac{1}{2}$	2·4	16	50	2·03
1	$2\frac{1}{2}$	2·5	42	130	5·18
$1\frac{1}{2}$	$3\frac{1}{2}$	2·34	90	300	11·7
$2\frac{1}{2}$	6	2·4	260	800	32·4
4	10	2·5	660	2100	82·8
6	15	2·5	1500	4700	187·0
10	25	2·5	4100	13000	518·0
15	36	2·4	9250	30000	1165·0

ORE-TREATMENT AT PIONEER GOLD MINES, BRITISH COLUMBIA

In the *Canadian Mining and Metallurgical Bulletin* for December H. J. Cain and Paul Schutz describe the ore-treatment at Pioneer Gold Mines of B.C., Ltd. The authors remind us that the property is located in the Lillooet mining district on Cadwallader Creek, 54 miles distant by motor road from Shalalth, a station on the Pacific Great Eastern railway. Milling by the present company was commenced in 1924, a small amalgamation plant, consisting of a crusher, Bryan mill, and plates, being operated until 1928. Tailing from this plant was impounded and later treated in the 100-ton continuous counter-current decantation cyanide plant which was erected during 1927–8 and placed in operation during May of 1928. A second cyanide plant, employing continuous counter-current decantation, having a nominal capacity of 200 tons, has been erected during the past few months and was put into operation during September of the present year.

ORE.—The ore as received at the mill consists chiefly of quartz carrying free gold, with small amounts of pyrite, arsenopyrite, and pyrrhotite in evidence, though probably amounting to less than one per cent of the total. Some gold is very closely associated with the sulphides. The country rock is a basic igneous rock, probably an augite diorite. Near the vein it is highly altered to sericite, which slimes readily on grinding, and does not settle very well. The quartz is of two types, clear and ribbon. In the latter, the ribbons, which are not much thicker than paper, consist of shattered sulphides. In crushing this ribbon quartz, breakage is often along the streaks, exposing these shattered faces to advantage in subsequent treatment. While gold is the metal for which the ore is mined, some silver is also present and is paid for by the mint. It is, however, unimportant from a commercial viewpoint. From the standpoint of crushing and grinding, the ore might be termed "medium hard."

FIRST UNIT OF MILL.—Test work on samples from the Pioneer mine were conducted in 1927 by the Dorr Company, with the result that they advised that the ore, as represented by the samples tested, was amenable to cyanide treatment after removal of coarse gold. Following this test work, Pioneer Gold Mines decided to erect a mill employing direct cyanidation, with the result that a 100-ton continuous counter-current decantation plant was built and production from it commenced in 1928. There have been some changes made in the first unit, prompted by changes in the ore as the mine was opened up. These will be mentioned after first describing the plant flow as originally installed.

Crushing.—The run-of-mine was passed over 5 in. grizzlies, the oversize being sledged and the undersize being crushed underground in a Blake-type crusher, 9 in. by 10 in., set at 1½ in. The crushed product was trammed to the mill and dumped into a 14 ft. by 40 ft. circular bin, holding about 300 tons.

Grinding and Classification.—Two-stage grinding in cyanide solution was practised, the ore being fed by a 16-in. belt conveyor to the primary ball-mill, an Allis Chalmers 5 ft. by 4 ft. overflow trunnion-type mill, operating in open circuit. This ball-mill discharged to a Dorr duplex classifier, model *C*-20, 4 ft. 6 in. by 21 ft. 8 in., which was in closed-circuit with the secondary mill, an Allis-Chalmers tube-mill, 4 ft. by 16 ft. The primary mill carried a load of 6,000 lb. of balls, while the secondary mill carried a load of 11,000 lb. Replacements in the former mill were 5-in., while 2-in. balls were used in the latter mill. Speeds were 28 r.p.m. for the primary and 30 r.p.m. for the secondary. The density in the primary mill was about 75%, while that in the secondary was about 70%.

The classifier was set on a slope of 2½ in. per foot and operated at a speed of 24 strokes per minute. A good circulating load was carried in this machine.

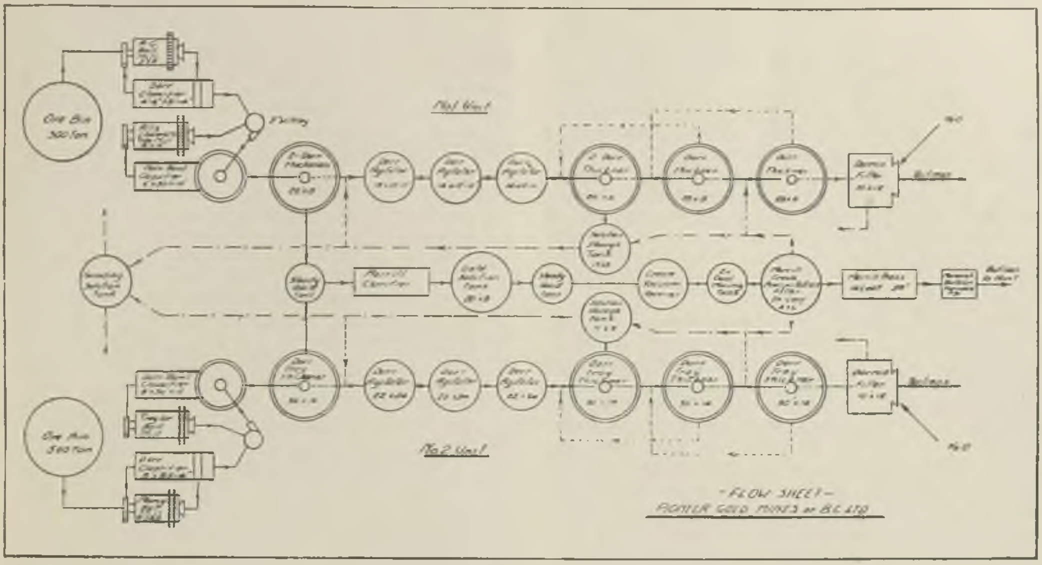
Thickening and Agitation.—Classifier overflow, at a density of about 20% solids and about 65% minus-200-mesh, was laundered to a Dorr thickener, type *R*, 20 ft. by 8 ft., which overflowed gold solution to a leaf-type clarifying filter consisting of 14 5 ft. by 6 ft. leaves, followed by precipitation by Merrill-Crowe process. Underflow from the primary thickener, at 50% solids, was elevated by a Dorrco No. 4 simplex diaphragm suction pump to an agitating series consisting of three Dorr agitators, type *S*, 14 ft. by 15 ft. 11 in. Counter-current washing of the agitated sludge was carried out in four thickeners of the same size and type as previously mentioned, with re-pulping by air lifts being practised between thickening steps. Sludge from the final thickener was discharged to waste, care being taken to thicken to maximum density before discharging.

After operating this plant for a number of months, it was found that more sericite schist was coming to the mill, with the result that settlement in the thickeners was being retarded somewhat. As it was not practicable at that time to avoid this material, it was decided to provide more settling area. This was accomplished by doubling-up the 20-ft. thickeners, using two in parallel in both the primary and first secondary step, and installing a 28-ft. thickener for each of the remaining decantations.

During 1929 it was noticed that sulphides were being encountered, to the extent that somewhat finer grinding was required to permit of satisfactory recovery. It was suggested that advantage could be taken of selective grinding of sulphide particles, made possible through classification in a bowl classifier, with the result that a Dorr bowl classifier, type *DSDB*, 6 ft. by 30 ft. by 10 ft. diameter bowl, was installed in the mill. This classifier was placed in closed-circuit with the tube-mill and the straight classifier with the ball-mill. In common with practice at other gold mills where the bowl is used, it was found that the sulphide particles were ground finer than the quartz, with an appreciable additional saving resulting.

Toward the end of 1931 a continuous rotary vacuum filter was placed at the end of the decantation series for the purpose of further washing the residue and to minimize the amount of cyanide, leaving with the tailing, passing into the creek

Water and Power.—Water for milling operations is taken from Cadwallader Creek, which flows by the mill Power for the first unit and initial mining operations was developed on this creek by damming it about a mile above the camp. Water to operate Pelton wheels in the mill is brought to the mill through about 6,000 ft. of 36-in. wood stave pipe, built on the job from lumber cut in the company's sawmill. About 600 h.p. is developed at this point. While the



various drives in the first unit are now operated by electricity, the old line-shafts have been retained, so that this unit can be operated direct from the water wheels in the event of interruption of electric power. During 1931 about 750 h.p., additional to the above, was developed on Hurley Creek, through the building of a modern hydro-electric plant.

Second Unit of Mill.—By midsummer of 1931 mining operations had reached the stage to warrant consideration being given to possibilities of mill expansion, with the result that a second mill was started during the winter. This unit has recently been put into operation. In its design an endeavour has been made to conserve space with the view toward further enlargements when justified by mine developments. Also every effort has been made to provide maximum flexibility in operation. In this second unit, as in the first, continuous counter-current decantation, followed by filtration, is employed.

Crushing.—Grizzly bars spaced at 5 in. are located at dumping points underground, the undersize being hoisted in two-ton skips through the new two-compartment shaft. From a receiving bin a Hardinge constant-weight feeder delivers the ore to a 21-in. conveyor belt, above the head pulley of which is located a 29-in. Ohio magnet for removing tramp steel ahead of the crusher. A Hum-mer screen, 7-16 in. by 1¼ in. openings, set for ½-in., is located ahead of a Traylor bell-head crusher, No. 37, type *TZ*. This crusher is driven by a 75 h.p. C.G.E. slip-ring motor, at a speed of 1,145 r.p.m., through a texrope drive. The same motor also drives the generator which furnishes the current to the magnet. A 21-in. belt conveyor, 50 ft. long, carries the undersize of the screen and the crusher product to a bin ahead of a two-bucket aerial tram, which transports the ore to the mill about 300 ft. distant. The tram buckets, each holding about 1,500 lb. of ore, discharge automatically into a chute, from which ore can be passed to fine-ore bins in either mill unit. Thus both units now receive similar ore and this finer feed makes it possible to step-up the tonnage through the original unit.

A Geary-Jennings automatic sampler located above the bin, at the upper terminal of the tramway, cuts the ore stream every twenty minutes. The sample cut out is riffled to one-sixteenth of its original volume after passing through sample crushers.

Grinding and Classification.—In the second unit of the mill the fine-ore bin is 17 ft. diameter by 40 ft. high, holding about 500 tons of ore. Ball-mill feed is drawn from this bin on to a 21-in. feeder belt conveyor, equipped with an adjustable ratchet-type drive at the head pulley. The ore is ground in cyanide solution in a Marcy ball-mill, No. 64½, driven by a 100 h.p. C.G.E. slip-ring motor, operating at 870 r.p.m., through a texrope drive. The ore-feeder belt is driven from a pulley on the pinion shaft of the ball-mill through a quarter-turn belt.

The Marcy ball-mill, equipped with a 48-in. radius feed scoop, is in direct closed circuit with a Dorr duplex classifier, model *DSF*, 8 ft. wide by 21 ft. 8 in. long. The classifier is equipped with a 7½ h.p. C.G.E. motor, and texrope drive, mounted on the classifier tank. A Dorrco motor-driven chip remover is mounted on the rear of the classifier. The primary ball-mill carries a load of 10,000 lb. of forged chrome-steel balls, 4 in. diameter. The liners are of chrome-steel. The speed of the mill is 26 r.p.m., the density carried being about 75%.

The primary classifier operates at 28 strokes per minute and is set on a slope of 3⅝ in. per foot. By the use of a unique method of constricting the settling pool in the classifier, it is possible to overflow a product at any desired degree of coarseness, thereby permitting unusual flexibility in balancing the work between the primary and secondary grinding circuits.

The secondary grinding section consists of a Traylor ball-mill, 6 ft. by 7 ft., in closed-circuit with a Dorr bowl classifier, 8 ft. by 30 ft. by 12 ft. diameter. The ball-mill speed is 24 r.p.m., being driven through a texrope drive by a 150 h.p.

C.G.E. slip-ring 900 r.p.m. motor. This secondary mill is equipped with a 48-in. radius feed scoop to permit its being directly closed-circuited with the primary classifier, in the event of the primary mill being down for re-lining. The Traylor ball-mill carries a load of 17,000 lb. of forged steel balls, 2-in. balls being added daily. The density of pulp in the mill is kept at about 70% solids. The discharge from this mill is laundered to a sump, where it is joined by the overflow of the primary classifier, and the combined pulp is pumped by a Wilfley 4-inch pump to the Dorr bowl classifier, located at a higher elevation than the grinding mills. The Wilfley pump is direct connected to a 15 h.p. 850 r.p.m. motor.

The bowl classifier is driven by a 10 h.p., 870 r.p.m., C.G.E. motor, through a texrope drive, the driving unit being mounted on the classifier tank. This Dorr bowl classifier, model *DSFB*, is set on the customary slope of 2 in. per foot, and operates at a speed of 4 r.p.m. in the bowl and 26 r.p.m. in the reciprocating rake compartment. Both this machine and the primary classifier are equipped with quick-opening gates in the rear end, permitting quick draining in the event of prolonged power interruption at any time.

The grinding sections have been laid out with the view to permitting maximum flexibility. Either mill can be operated independently of the other, in the event of one being down for re-lining or other reasons. In line with present practice of carrying high circulating loads in the grinding circuits, it is the intention to carry high sand loads in the classifiers and, to permit this, classifiers with ample raking capacity are used.

Thickening and Agitation.—Bowl classifier overflow, at a density of about 17% and fineness of 80% minus-200-mesh, is laundered to the primary thickener. All thickeners in this new unit are Dorr balanced tray thickeners, type *RTB*, 30 ft. by 14 ft. These two-compartment thickeners were installed with the object of conserving space and keeping the plant as compact as possible, consistent with good practice. Assurance had been given, prior to their installation, that these balanced tray thickeners would have 100% more capacity than single-compartment thickeners of the same diameter.

Overflow from this primary thickener, constituting the gold solution, passes to clarification, while the underflow, at 50% solids, is lifted by a Dorrco No. 4 duplex diaphragm suction pump to the first of a series of three agitators. Three Dorr agitators, type *H-D*, 22 ft. by 24 ft., are used in series. Agitation of pulp is conducted at a dilution of about 1½ : 1, barren solution being added at the head of the series to raise the dilution to the desired degree. The speed of the agitators is 5 r.p.m., while that of the thickeners is 1/5th r.p.m. Between the third agitator and the first of three secondary thickeners, a Dorrco re-pulper, type *SB*, 15 in. by 15 in. by 18 ft., is used to thoroughly mix the agitated pulp with the washing solution. Similarly, re-pulpers of the same type and size are used between the different thickeners of the washing system.

The difference in elevation of thickener tanks in a continouus countercurrent decantation plant using balanced tray thickeners must be somewhat greater than where simple one-compartment thickeners are used, due to the fact that a small head must be provided for introducing pulp to the lower compartment of the tray thickeners. It was noted during the design of this plant that the underflows from the second and third thickeners had to be raised about eight feet above the levels of solution in these respective thickeners. The usual type of diaphragm suction pump would be labouring under a disadvantage under these conditions, so Dorr Inspiration-type No. 4 duplex diaphragm suction pumps are used for this purpose. These pumps differ from the usual suction pump in that the customary solid eccentric rod is replaced with a hollow pipe through which the pulp is discharged at an elevation of about five feet above the pump bowl. All diaphragm pumps are operated at 66 r.p.m., it being the experience at this plant that faster speed and shorter stroke result in long diaphragm life. In the first unit, cord diaphragms last from 18 months to 3½ years, which is probably a record in cyanide operations.

The four thickeners, four duplex diaphragm pumps, and re-pulpers are belt-driven from a line shaft, which is in turn driven by a 25 h.p. C.G.E. 900 r.p.m. motor through a double reduction Gilmer multi-*V*-belt drive. The agitators are driven from a line shaft, which is driven by a 20 h.p., 1,200 r.p.m., motor through a similar drive.

Filtration and Disposal of Tailing.—Final thickener underflow is given a water-wash in a Dorrco filter, type *BMSC*, 10 ft. by 12 ft., a duplicate of that used in the original unit. The filter operates at a speed of ½ r.p.m., being driven by a 7½ h.p. C.G.E. 1,200 r.p.m. motor, through a speed reducer and silent chain drive mounted on the trunnion end of the filter. With a 5-16-in. cake, a 24-in. vacuum is maintained, the moisture of the discharged cake being about 18%. Three lines of sprays are used in washing the cake, which is removed from the interior of the drum by a screw conveyor, because of its sticky nature.

Vacuum for the filter is provided by a Canadian Ingersoll-Rand vacuum pump, type *ER*-1, 22 in. by 9 in., driven through a texrope by a 40 h.p., 1,165 r.p.m., C.G.E. motor. Air at two pounds pressure to assist cake discharge is provided by a Connersville blower, No. 25-B, direct-connected to a 5 h.p., 870 r.p.m., C.G.E. motor. A Gould 1½-in. centrifugal pump, direct-connected to a 5 h.p. motor, handles the filtrate from the unit. Cake from the Dorrco filters in both units is re-pulped with water, so that it is quite fluid and is discharged through 3,000 ft. of machine-banded wood pipe to a point below the intake of the water-line of Bralorne Mines, Ltd.

Clarification and Precipitation.—With the building of the second unit of the mill, new clarification and precipitation equipment was installed to serve both sections. Pregnant solution from primary thickeners in both units goes to a 6 ft. by 8 ft. steady-head tank, ahead of a Merrill centre sluicing clarifying filter, 36 frames, 42 in. square, located in the new unit. A Krogh 3-in. pump forces the solution through the filter, from which it flows by gravity to a 20 ft. by 8 ft. storage tank in the older plant. The Krogh pump is direct-connected to a 15 h.p. Westinghouse 1,750 r.p.m. motor. The frames are covered with 10-oz. duck. The filter is sluiced for ten minutes every shift, with water under a pressure of 65 lb.

The clarified gold solution, amounting to 3 tons per ton of ore milled, flows by gravity from the gold storage tank to a steady-head tank, from which it is drawn to a Crowe vacuum receiver, where it is "deoxygenated." Zinc dust, "merrillite," at the rate of 0·06 lb. per ton of solution, is added to the solution in a mixing tank by means of an auger type feeder, after which precipitation is effected in a Merrill-Crowe low-level vacuum leaf filter, consisting of 24 4 ft. by 6 ft. leaves in a 10½ by 12 tank.

Clean-up and Refining.—A clean-up is made about every two weeks. Flow of solution to the precipitation filter is stopped, the solution remaining in the filter is withdrawn, and the precipitate on the leaves is sluiced-off with pregnant solution. This is pumped to a Merrill filter press, fourteen 54-in. leaves, located in the refinery. Only one hour and three-quarters is required to effect the clean-up of the precipitating filter. Air is blown through the press for about two hours for the purpose of drying the precipitate. Each frame of the press is provided with a 10-oz. duck cover and a paper cover. The latter is removed with the precipitate and burned in the melting furnace.

Melting and refining is conducted in a Monarch simplex furnace, No. 91, The resulting bullion, of about 900 fineness, is shipped to the Dominion Mint at Ottawa.

Handling of Solutions.—The barren solution resulting from precipitation is pumped to weir boxes ahead of the final thickeners in both units. The excess from the weir boxes flows by gravity to two tanks, 13 ft. by 8 ft. and 11 ft. by 9 ft., respectively. Overflows from the first secondary thickeners in each plant flow to the tanks mentioned. Solution from these tanks is pumped to a storage tank, 16 ft. by 10 ft., located above the grinding mills, and is used for dilution in the mills and classifiers.

Overflows from all thickeners flow by gravity in the counter-current system, the one exception being the overflow of the primary thickener in No. 1 unit, it being pumped to the steady-head tank ahead of the clarifier in the new unit.

GENERAL.—Cassel brand sodium cyanide, 97–98% NaCN, is added through drip boxes in both units at the primary and secondary grinding mills and at No. 1 and No. 2 agitators. Cyanide strength of the grinding solution is maintained at about 2·75 lb. to 3 lb. NaCN per ton solution. Consumption of cyanide is about 2·25 lb. per ton of ore.

Lime is added through drip boxes at the primary and secondary mills and ahead of the final thickeners. A strength of 0·7 lb. CaO per ton of solution is maintained in the grinding and pregnant solution. Lime consumption is 2·25 lb. CaO per ton of ore. Quick-lime is used exclusively. This was formerly purchased in the open market, but recently a quarry has been opened about two miles from the mine and the company is now burning its own limestone.

Lead acetate, amounting to 0·0012 lb. per ton of solution, is added to the pregnant solution in the steady-head tank ahead of the clarifying filter.

Concrete floors, protected by curbs, are used throughout the mill to guard against loss of solution in the event of leakage or spills. Liberal slope of floors is provided to ensure good drainage to mill sumps, which are served by bucket elevators.

Thickener, agitator, and solution tanks are made of fir, cut on Pioneer ground, and dressed into tank lumber at the company's sawmill. All lumber used in the construction of the plants was cut locally.

HANGING-WALL CONTROL IN DEEP-LEVEL MINES

Hanging-wall control in deep-level mines on the Witwatersrand and its ultimate effect on maximum ore extraction are discussed by B. T. Altson in a paper appearing in the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for October last. The author remarks that it is generally agreed that depth will be the limiting factor in the exploitation of the gold bearing area of the Witwatersrand. In making this general statement it is necessary to consider how this factor of depth will operate. The purely mechanical part of the difficulties, such as winding and pumping, will be overcome ; mechanical science on demand has always furnished machines to do the work. Development, shaft sinking, and the breaking and transport of rock will probably offer no greater problems than are experienced in the deeper mines to-day. The remaining factors are the support in the excavated areas and the ventilation of the mine. In this paper the author draws attention to certain methods of mining : (1) to enable adequate control to be obtained of the hanging ; (2) to assist in the circulation of air in the working faces ; and (3) to endeavour to obtain maximum extraction of payable ore in a deep mine. The possibility of the loss of large tonnages of payable ore in a deep mine, due to the incidence of bursts, is an issue seldom discussed. Such a factor should not be under estimated. Therefore, the necessity of adopting some method of control which will minimize this loss is of prime importance.

In the Central Rand the reef bodies dip at about 35°. On the Robinson Deep gold mine the maximum depth of stoping has reached 7,600 ft. ; this is the greatest depth on these fields to-day. In the City Deep the maximum depth is 6,600 ft. The foot- and hanging-walls of the reef body consist of medium to fine-grained quartzite. In structure, this rock, owing to its highly siliceous content, does not lend itself readily to any large bending movement. It is very hard and strong, and in these characteristics paradoxically lies its weakness. It will permit of a certain slag without giving cause for anxiety, but the dividing line between maximum sag and rupture is very sharply defined. It passes from the one state into the other without warning. As a general rule the reef body on the City Deep is developed from foot-wall drives carried from 100 ft. to 150 ft. in the foot-wall of the reef. Cross-cuts are put out to the reef at intervals of approximately 500 ft. The length of back varies, being either 250, 350, or 500 ft. By the normal process of mining, each rise, irrespective of its length, will ultimately produce at least one, possibly two, remnant blocks. If faulting is encountered the number of remnants per rise will be increased. In his notes the author suggests ways and means of allocating positions to these remnants and methods of mining them with the minimum loss of their gold contents and in comparative safety.

In the earlier days on the Central Rand it was found that these small blocks, and similar ones that had been left as support pillars, gave trouble when attempts were made to extract them. Attention was focussed on the subject by numerous accidents and by the attendant tremor felt on the surface. In 1908 and again in 1915 committees were appointed by the Government to inquire into and report on the origin and occurrence of these tremors. In 1924 the Rock Burst Committee was appointed to inquire into the occurrence and control of rock bursts. This committee issued a very full and detailed report, and many of its recommendations are to-day common mining practice. Amongst the voluminous evidence given before the committee, an extract from that of the U.O.A. of South Africa is not without significance. Under paragraph 7, section (b), referring to methods of mining and support of workings is stated : " The most efficient method of supporting the hanging of workings is totally to refill the worked-out areas ; whilst, undoubtedly, this is theoretically correct from the economic point of view it would not be practicable."

In 1928 a paper by J. Thorlund on " Some Aspects of Deep Mining " referred to mining practice at that date on the Village Deep. A block of ground was mined until it was approximately 400 fathoms in extent, and then abandoned, it having been found that if mined to a smaller size it was certain to burst. In 1931 P. J. Crowle published a most instructive paper on " Methods of Support in Deep Mining on the Kolar Goldfields." He stated that for many years he had tried various methods of support. He arrived at the conclusion that granite blocks built as dip packs on pigsty stulls on an ore-body dipping at 85° proved the most efficacious. He concludes by saying " the packs are providing sufficient compressibility to avoid their own destruction, while they steady the ground movements and minimize the effect of heavy bursts." In a paper recently read before the Chemical and Metallurgical Society of South Africa by C. J. Gray on " The Effect of Crush Burst Movements," certain statistics were given which appeared to show that the all-important subject of rock bursts was not receiving the attention it deserved. The author feels that we are a little nearer a partial solution of this far-reaching and engrossing subject. The figures of fatalities in the paper referred to are highly disturbing, but too much importance should not be attached to them ; they are without doubt largely governed by fortuitous circumstances.

After dealing with such accidents the author goes on to say that the use of the word " supporting " in connexion with mining is in a way rather unfortunate. Literally, " to support " means " to sustain " or " to hold up." Speaking now for the information of the younger members of our profession—this is not what we wish to imply when talking of " the support of workings." The main function of so-called underground support of the hanging-wall is not for the purpose of " holding it up," but, on the contrary, to allow it to subside under complete control. Therein lies the essential difference between the methods of controlling the hanging-wall that exist to-day on deep-level mines.

The author then discusses :

(i) The type of hanging control employed in the surrounding area and its influence on subsequent operations.

(ii) The placing of the remnant in its correct initial position relative to the effect it is likely to have, due to tunnels, dykes, etc., etc., in the vicinity.

(iii) The production of the most suitable shape for the remnant and the type of hanging control necessary for its successful extraction.

In concluding a detailed discussion of the final section, the author points out that the Rock Burst Committee in 1924 recommended that the hanging-wall portion of a stope face should be kept in advance to lessen the danger of the sudden drag of the hanging-wall causing the breaking-off or flying-off of brows likely to be formed. The difficulty regarding this point in a remnant working on pigsties or on shrinkage is a very real problem from the practical side, and the author knows of only one means of overcoming it, especially where the foot-wall of the stope has a fairly good parting. We have previously tried stab holes, but although they may produce the desired effect for a short period the face itself always tends to break away on the bottom parting, leaving the overhanging brow. Where the reef channel is wide, viz., 48 in. and over, this is mined by a form of modified resue, depending on the position of the higher grade bands. If these grade bands should be in the middle, or the top of the stope face, the mining of this face is performed by stoping out the upper portion first to a distance of from three to five feet, tramming out the broken rock and supporting either on mat packs, if necessary, or timber props ; then foot-walling the lower grade bands and packing them as shrinkage. Should the position be reversed and the higher grade bands be below the middle or on the foot, this necessitates the stoping out of the upper portion of the face first and storing that as shrinkage, until the fill nearly reaches the ledge thus formed, and then foot-walling the higher grade bands and sending them out. In either case the hanging-wall of the face is in advance, and the trouble of the overhanging brow is avoided. In the case of hanging-wall resue on a narrow reef or foot-wall resue on a medium reef body no overhanging brow can form. The temporary support in a remnant in any of these latter cases can be mat packs or timber props. The liability of large falls of hanging-wall at the face when a crush burst occurs in an area which has been resue-filled, or shrinkage-filled and unreclaimed, is certainly far less than would be the case in an area supported on pigsties.

The author is not in favour of any form of collapsible metal support. The difficulties which follow when one attempts to enter any remnant after a burst are bad enough as it is without having the added difficulty of having to cut out sections of steel girders or iron pipes, which would cause considerable delay in any rescue operations. To put the matter bluntly, if a severe crush burst does occur in a remnant there is nothing the human mind can devise to withstand the intensity of the crush. Our aim should be to endeavour to prevent the forces which are the cause of these severe bursts from coming into action, and if this is also entirely outside our control, which the author does not altogether admit, then we should endeavour to minimize the severity of the burst by ensuring that part of its violence is expended or absorbed in the large surrounding area ; and this can only be looked for where the support in the area excavated approximates to complete initial fill.

In the case where two reefs are being mined, the author considers that wherever possible the rises should be developed one directly on top of the other and that the stope faces working on the top reef should be mined in advance of those on the lower reef. If one of the upper faces is about to assume its initial stage remnant position, the corresponding lower reef face should be stoped until the upper reef remnant is mined out. It is unfortunately not always possible to achieve this, but it should certainly be the position to aim at. On the

City Deep it has been definitely proved that resue fill stoping is economically sound, and without doubt it must receive serious consideration as the future method of mining at depth. To Mr. A. V. Lange, Manager of the City Deep, every credit must be given for the successful introduction of the resue waste fill system in a deep-level mine. The safe conditions obtaining to-day underground are a testimony to his perseverance in spite of the greatest economic and practical difficulties.

NATURAL AND MECHANICAL VENTILATION

The relationship between natural and mechanical ventilation is discussed by R. A. H. Flugge-de Smidt in the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for September. The author says that when quantity and pressure are measured in a fan-drift the energy imparted to the air by the fan alone is measured and whatever the effect of natural ventilation may be it is hidden because it is not included in these figures and has to be determined by special methods. The object of his paper is to discuss the probable relationship between natural and mechanical ventilation and to show that the method of analysis arrived at can be made use of in a practical manner.

Natural Ventilation.—Natural ventilation may be defined simply as the effect caused by the air being of different density in different parts of a mine circuit. The study of natural ventilation in a mine where no mechanical ventilation is installed is a simple matter and is too well-known to require description. When a fan is operating in a mine the true effect of natural ventilation is not generally understood. The effect may be to decrease, but more generally to increase, the amount of air circulated.

The density of air is controlled by three factors, namely—temperature, humidity, and pressure. In a mine ventilated by natural means only the density of the air in any portion of the circuit is affected by temperature and humidity alone, but, if a fan is installed to increase the circulation, pressure differences as well are set up. These pressure differences alter the density of the air and tend either to increase or to decrease the temperature and humidity effect according to the position of the fan in the circuit.

Temperature and Humidity.—If a mine be ventilated first by natural means only and have only two shafts, a certain average quantity Qn will circulate. There will be seasonal variations. If now a fan be placed on the top of the upcast shaft to increase the total quantity, then the mere fact of pulling cool air in winter more quickly down the downcast shaft will tend to cool the rock more and more and store up an effect that will last well into the summer. The general effect will be to lower the average temperature in the downcast shaft, while the temperature in the upcast shaft will hardly change. Thus the action of a fan can and generally does increase the temperature effect so that a part of the so-called natural ventilation is due to the fan itself and the average quantity Qn′ will be greater than Qn.

In most cases, when fans are in operation, the quantity that will circulate when the fan is stopped is measured shortly after the fan has been stopped and includes the extra temperature effect that has been produced by the fan itself. Temperature conditions after a fan has been stopped remain sufficiently steady for a considerable period, so that the quantity circulated is easily measured before any change takes place.

Pressure.—It is a well known fact that the pressure differences set up by a fan do change the density of parts of a mine circuit, but that the change is sufficient to be of any consequence is not generally known. All pressure effects are at a maximum when the fan is running at full speed. All such effects die down in a few minutes after stopping a fan and are not included in the usual measured quantity of natural ventilation.

That the pressure effects produced by a fan are not necessarily negligible can best be proved by a simple example, illustrated in Fig. 1 :—

Two shafts each 4,000 ft. deep, A–B and C–D. Workings B–D horizontal.

Quantity circulated by a fan = 400,000 C.F.M.

Shaft A–B : Temperature averaged out from top to bottom in fairly cool weather = 60° F. dry and 55° F. wet.

Shaft C–D : Average temperature = 76° F. saturated.

Note : This temperature difference of 16° F. is by no means abnormal. In one of the mines on the Far East Rand in winter a gap of 32° was actually measured.

Surface Barometer = 24·5 in. mercury.

(*a*) *Fan Exhausting at C.*

(1) *Temperature effects alone considered.*

Barometer at B and D = 28·4 in.

Under these conditions we obtain :—

Average density downcast = ·06712
Average density upcast = ·06462

Difference = ·00250

For 4,000 ft. this difference
= 10·0 lb. per sq. ft.
= 1·92 in. W.G.

(2) *Temperature + Pressure Effects : Assumption.*

Pressure drop in downcast = 3·5 in. W.G.
,, ,, workings = 2·0 in. W.G.
,, ,, upcast = 4·0 in. W.G.

Total = 9·5 in. W.G.

Correcting barometer at B, D, and C for the rarefying effect produced by these pressure differences :—

We obtain : Bar. at B = 28·143
,, D = 27·996
,, C = 23·8

and : Average density downcast = ·06680
Average density upcast = ·06325

Difference = ·00355

For 4,000 ft. this difference
= 14·2 lb. per sq. ft.
= 2·73 in. W.G.

(*b*) *Fan underground at D exhausting up the upcast shaft.*

(1) *Temperature effects* : These remain the same as in case (*a*) (1), i.e. W.G. = 1·92 in.

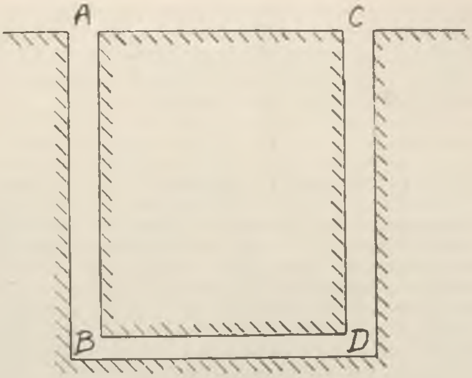


Fig. 1.

(2) *Temperature + Pressure Effects* :

In the downcast the pressure conditions remain the same as in case (*a*) (2).

In the upcast the fan is now compressing the air.

Bar. at C. = 24·5.

Bar. at D on pressure side of fan = 28·4 (+ 4 in. W.G.) = 28·694.

Thus we obtain :

Average density downcast	=	·06680
,, ,, upcast	=	·06498
Difference	=	·00182

For 4,000 ft. this difference
= 7·28 lb. per sq. ft.
= 1·40 in. W.G.

Thus the fan at the bottom of the upcast shaft produces pressure effects that operate against the temperature effects.

To determine the assistance or otherwise of natural ventilation actually given to a fan while running.—Take the same example as before :—

(*a*) *Fan on Surface.*

Temperature effects = 1·92 in. W.G.
9·5 in. circulates 400,000 C.F.M.

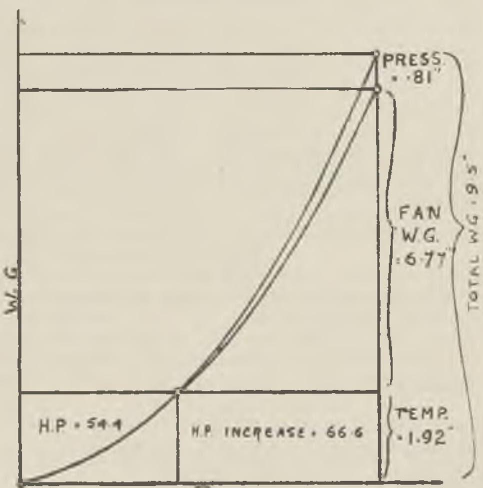


Fig. 2.

∴ 1·92 would circulate 179,800 C.F.M.

i.e. when the fan stops 179,800 C.F.M. would circulate.

All the figures can be plotted in a graph as in Fig. (2) showing W.G. and volumes.

Temperature effect produces	.	1·92 in. W.G.
Pressure effect produces .	.	0·81 in. W.G.
∴ Fan must produce .	.	6·77 in. W.G.
		9·50 in. W.G.

It will be noticed that the horse-power produced by the temperature effect is 54·4, when the fan is stopped and this increases to 121·0 when the fan is running. The increase in horse-power is created by heat transference and, provided the temperatures remain constant, the extra power is explained by the fact that more heat is abstracted from the earth when larger volumes are passing. The fan is thus able to unlock a source of energy. The fan therefore is assisted to the full extent of 2·73 in. and only has to produce a pressure of 6·77 in. to circulate 400,000 C.F.M.

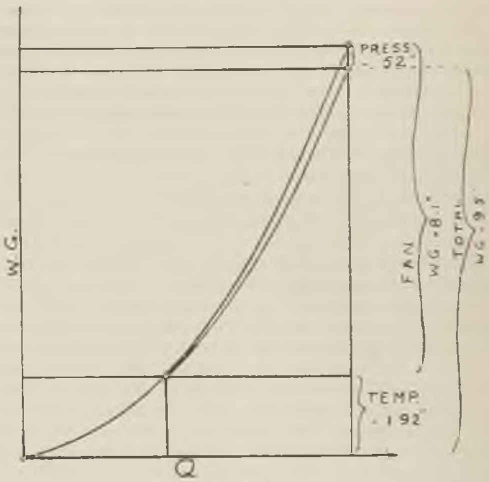


Fig. 3.

(*b*) *Fan underground* :

Temperature + pressure effect =		1·40 in. W.G.
∴ fan must produce .	.	8·10 in. W.G.
		9·50 in. W.G.

The temperature effect remains the same, but the pressure effect operates against the fan. Thus to circulate 400,000 C.F.M. under the given conditions a fan at the surface has to produce a W.G. of 6·77 in. while a similar fan placed underground will have to produce a pressure difference of 8·10 in. to circulate the same quantity.

These rough and ready figures serve merely to indicate that a fan placed underground has to surface to circulate the same quantity or weight of produce a much larger W.G. than a fan on the air. At first blush it would appear as if the fan underground would consume more horse-power than the fan on the surface, but when due allowance is made for the difference in volume the difference in horse-power amounts to very little.

To obtain a direct comparison more accurate figures are necessary. In the example quoted it was assumed that the whole of the total pressure of

9·5 in. in the case of the fan on the surface caused a rarefaction. Actually only the fan W.G. produces rarefaction—the natural ventilation probably exerts a positive pressure. Thus the 0·81 in. pressure effect was too high and the fan W.G. in consequence too low.

One can assume that the conditions as regards quantity, density, pressure, etc., are identical in both cases from the inlet to the bottom of the upcast shaft A–D. The only change is in the upcast shaft itself (D–C).

Assume as a basis 400,000 C.F.M. exhausted to atmosphere at 72° sat. Temperature at bottom of upcast 80° sat. Normal barometer surface 24·5 in. Normal barometer shaft bottom 28·4 in.

(*a*) *Fan on surface* :

W.G. = 6·77 in.
Bar. in fan-drift = 24·0 & Vol. = 408,333 C.F.M.
Bar. shaft bottom 28·4 (− 3·77 in.) = 28·123 & Vol. . = 353,630 C.F.M.

Average Vol. . . = 380,981
H.P. = 240·1

(*b*) *Fan underground* .

Bar. surface 24·5 & Vol. . = 400,000 C.F.M.
Bar. fan delivery 28·4 (+ 3·92 in.) Vol. . . . = 346,730 C.F.M.

Average Vol. . . = 373,365 C.F.M.
H.P. . . = 230·6

(*Note*—3·92 in. obtained by trial and error.)

Thus the actual horse-power required to pull a given weight of air up a shaft is appreciably more than the horse-power required to push the same weight up from the bottom.

Friction varies directly as density (K = C.w.)

Volume varies inversely as density $\frac{1}{(W)}$

Drop in pressure varies as $K.V^2$

$\therefore V^2$ predominating factor

$$p \propto K.V^2 \propto \frac{w}{w^2} = \frac{1}{w}$$

$$H.P. \propto P.V \propto \frac{1}{w^2}$$

This factor probably wipes out any assistance given to the fan on the surface by the greater N.V.P.

As regards horse-power required to circulate a given weight of air the writer is of the opinion that a fan underground is more advantageously situated than a fan on the surface. When one comes to consider velocity pressure the balance, slight as it may be, is again on the side of the fan situated underground because velocity pressure also varies as $W.V^2$.

MEASUREMENT OF NATURAL VENTILATION PRESSURE.—From time to time various methods have been advocated to obtain the pressure due to natural ventilation. In 1872 Murgue, by stopping a fan and closing the fan-drift, made a direct measurement of the natural ventilation pressure. The same method has been adopted on Government Gold Mining Areas. This method however cannot hope to capture the very elusive pressure effect. Professor Henry Briggs suggested setting the doors for reversal and by starting the fan very slowly until the flow of air in the upcast ceased the pressure registered at this point should equal the natural ventilation pressure. Again the pressure effect due to the fan would be lost or even reversed. A detailed pressure survey should give the required result. Such surveys require a number of observers and are very complicated in a mine with a number of shafts.

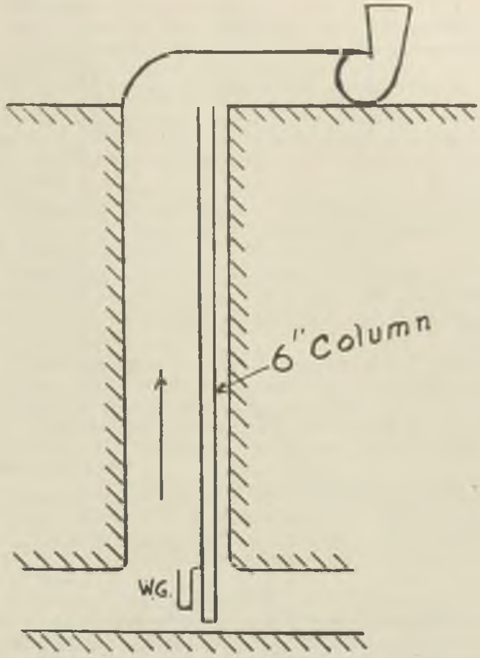


FIG. 4.

By altering the speed of a fan and plotting W.G. against Q^2 one should be able to obtain the N.V.P. graphically. Most of our fans are electrically driven and it is not possible to vary the speed. The following method was adopted on the Geduld Proprietary Mines.

Practical Application of the Principles Discussed.—

GEDULD.—No. 3 shaft. Fig. 4.
Depth of Shaft = 1,830 ft.
Quantity circulating = 300,000 C.F.M.

A 6 in. column in the shaft is open at the top of the shaft and a water-gauge is attached as in sketch a few feet above the bottom to allow for moisture collecting.

Water gauge readings :—

(1) Fan running = 6·25 in.
(2) Fan stopped = 0·71 in.

Aneroid readings—also at bottom of upcast :—

(1) Fan running = 25·082 in. mercury.
(2) Fan stopped = 25·325 in.

Difference = 0·241 3·28 in.W.G.

Analysis :—6·25 in. W.G. represents a direct reading of the drop in pressure to force 300,000 C.F.M. through the shaft. 0·71 in. represents the drop in pressure required to force the quantity circulating, when the fan is stopped, through the shaft.

6·25 in. circulates 300,000 C.F.M.
∴ 0·71 in. circulates 101,110 C.F.M.

3·28 in. W.G. represents the difference between the total ventilating drop in pressure that will

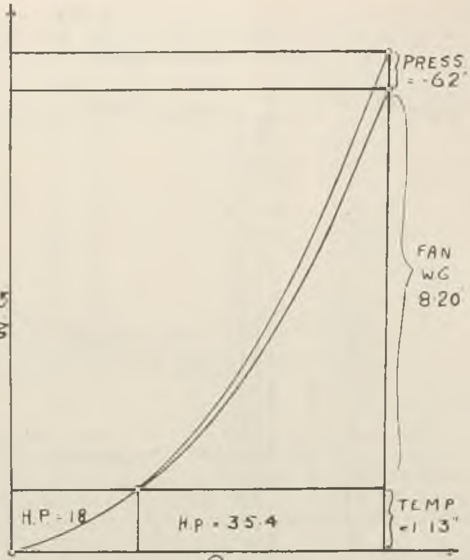


FIG. 5.

circulate 300,000 C.F.M. and the drop in pressure that will circulate 101,110 C.F.M. through the remainder of the mine, i.e. from the surface through the downcasts to the bottom of the upcast.

3·28 in. + X in. circulates 300,000 C.F.M.
& X in. circulates 101,110 C.F.M.
∴ X = 0·42 in. W.G.

Thus 3·28 + 0·42 = 3·70 in. W.G. is the total ventilating drop in pressure required to force 300,000 C.F.M. from the surface to the bottom of the upcast.

We now obtain the total drop in pressure for the whole mine :—

Upcast only	= 6·25 in. W.G.
Downcasts and workings .	= 3·70 in. W.G.
Total	= 9·95 in. W.G.
Fan drift W.G.	= 8·20 in. W.G.
∴ Density effect . . .	= 1·75 in. W.G.

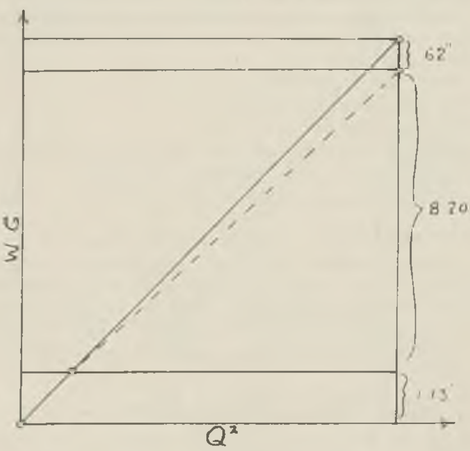


FIG. 6.

Thus by practically direct measurement we obtain the water-gauge increment to the fan water-gauge representing the full effect of the so-called natural ventilation while the fan is operating, as well as the proportions that can be credited to temperature and to pressure effects.

The results are plotted in Fig. (5).

Temperature effect = 0·71 in. + 0·42 in. . .	= 1·13 in. W.G.
∴ Pressure effect	= 0·62 in. W.G.
Density effect	= 1·75 in. W.G.

Fig. 6 shows W.G. plotted against Q^2.

In these observations it has been assumed that the density effect is a resultant of various forces, for when the fan stops the circulation reverses in parts of the mine. As an instance of the changeability of natural ventilation it may be mentioned that in a few weeks, owing to the advent of warmer weather, the volume of natural ventilation dropped from 101,000 to 62,000 C.F.M. and the N.V.P., due to temperature only, to 0·4 in. W.G.

In the same *Journal* for November, 1925, the author published a small paper entitled "The effect on the Ventilation Current of Stopping and Starting a Main Fan." In this paper the fact that pressure effects die down in a few minutes was proved ; also in Fig. 11 it was shown that on starting up the fan for a few minutes it actually circulated more air before the compression in the upcast shaft was complete.

SUMMARY.—In the paper attention is drawn to the quite considerable pressure effects that can be produced by a fan and a direct method of measuring N.V.P. is indicated.

The notes on the difference between a fan on the surface and a fan underground do not presume to be conclusive.

Scheelite at Kramat Pulai.—In a paper read before the Geological Society of London on November 23 E. S. Willbourn and Dr. F. T. Ingham described the geology of the Kramat Pulai scheelite mine in Malaya. The authors said that there are a number of occurrences of scheelite-ore at Kramat Pulai, one of them of considerable dimensions, and the ore is of unusual character, being a coarse-grained intergrowth of fluorite and scheelite, with less than 1% of other minerals. The granite which built up the great main range of the Malay Peninsula was the source of the ore, as it was also of the rich tin-deposits that are worked there. Kramat Pulai is situated on the contact-zone between the huge plutonic mass and the limestone into which it is intruded. The limestone was converted to marble by the intense folding and thermal action that accompanied the intrusion, and an interstratified bed of shale and silt was metamorphosed to pyroxene-schist and biotite-schist.

Gently pitching anticlinal structures were imposed upon the metamorphosed rocks, and minor faults at right angles to them were occupied by aplite-dykes. A reopening of the fissures brought in pegmatitic material, the interaction of which with limestone freely developed the minerals idocrase, andradite, and axinite ; at the same time cassiterite was deposited. Later, still another reopening of fissures occurred, permitting solutions rich in tungsten-fluoride to have access to the limestone below the schist-bed. The solutions were dammed back under the anticlines, and their reaction with limestone formed the crystalline intergrowth of scheelite and fluorite which constitutes ore-bodies Nos. 1 and 2.

After the ore had solidified, renewed earth-movement led to faulting, which caused small displacements in the ore and resulted in portions of it being deposited in veins in the neighbouring schist. It is significant that all the scheelite-fluorite ore is of identically coarse texture, whether it occurs in a large mass more than 100 feet across or in a thin vein 1 inch thick of secondary origin. The temperature of formation of such thin veins must have been low. No doubt the presence of very abundant fluorine kept the ore long in a fluid state, causing it to be deposited under conditions of low temperature that have not been recorded before.

Open-Pit and Underground Gypsum Mining.—The methods employed in recovering gypsum by both open-pit and underground openings at Arden, Nevada, are described in detail by W. G. Bradley in Information Circular 6615 of the United States Bureau of Mines. It is not often an operator finds conditions such that he can mine a deposit by both underground and open-pit methods at the same time. The paper discusses briefly the geology of the deposit, the method of exploration used, the mining methods in considerable detail, and the tramway and crushing and screening equipment. Detailed costs are shown in both dollars and cents and in man-hours per ton in two tabulations for the entire year 1930. The report is complete with illustrations of equipment, flow-sheets, and organization chart.

Ore Treatment at McIntyre Porcupine.—In a digest of an article by W. F. Boericke in the October issue of the MAGAZINE a statement that the single flotation cell on the discharge of the tube-mills at the McIntyre Porcupine reduces the gold content of the classifier overflow 25% was in error. The superintendent of the mill, Mr. J. J. Davey, has informed Mr. Boericke that it actually reduces the gold content 50% and that, in addition, there is no return from the secondary flotation cells to the classifiers.

SHORT NOTICES

Mining Costs.—M. J. Elsing calculates the average cost of mining by various methods in the *Engineering and Mining Journal* for December.

Tunnelling.—A paper by D. J. Rogers on the driving of the deep adit at the Stan Trg mine, Yugoslavia, appears in the *Bulletin* of the Institution of Mining and Metallurgy for December.

Concreting a Shaft.—The concreting of a shaft at Bisbee, Arizona, is described by F. B. Brunel in the *Engineering and Mining Journal* for December.

Sintering.—Sintering practice at the plant of the International Nickel Corporation at Coniston, Ontario, is described by H. Roach in the *Canadian Mining and Metallurgical Bulletin* for December.

Milling Gold Ores.—Dr. G. Quittkat, in the *Canadian Mining Journal* for December, describes milling practice at Roumanian gold mines.

Gravity Milling.—The work of the newly-designed Hadsel mill at Georgetown, California, is described by J. B. Huttl in the *Engineering and Mining Journal* for December.

Cyanidation.—H. Vincent Wallace discusses the loss of oxygen in cyanide solutions in *Mining and Metallurgy* for December.

Flotation Cyanidation.—In the *Engineering and Mining Journal* for December developments in flotation-cyanidation practice are discussed by L. E. Tucker and S. J. Swainson.

Ore-Treatment at St. John del Rey.—J. H. French and H. Jones describe reduction works practice at Morro Velho, Brazil, in the *Bulletin* of the Institution of Mining and Metallurgy for December.

Flotation at Lüderich.—Flotation practice at the Lüderich mines, near Cologne, is described by W. Finn in *Metall und Erz* for December 2.

Flotation.—The advantages of flotation for concentrating lead-silver ores are discussed by M. Gratacap in *Mines, Carrières, Grandes Entreprises* for November.

Flocculation.—In the *Iron and Coal Trades Review* for November 25 there is a synopsis of a paper on flocculation in coal-washery water read by J. O. Samuel at a meeting of the South Wales Institute of Engineers held in Swansea on November 15.

Pure Beryllium.—An article in the *Chemical Age* for October 1 last gives details of research on the preparation of pure beryllium taken from a paper by H. A. Sloman presented to the Institute of Metals.

Iron-Ore Reduction.—G. C. Williams and R. A. Ragatz discuss the effect of sodium carbonate on the low-temperature reduction of iron ores in *Industrial and Engineering Chemistry* for December.

Lead-Containing Flue-Dust.—The transport and treatment of lead-containing flue-dusts are described by H. Brill in *Metall und Erz* for December 1.

Bituminous Sand.—The hot-water separation of bitumen from Alberta bituminous sand is described by K. A. Clark and D. S. Pasternack in *Industrial and Engineering Chemistry* for December.

Protective Filming of Liquids.—C. W. B. Jeppe and B. Segal give some notes on the protective filming of liquids in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa for October last.

Placer Drilling.—Testing methods for placer deposits are described by J. Hume Robertson in the *Canadian Mining Journal* for December.

Geophysical Surveying.—An account of a paper read by Professor Poole, J. T. Whetton, and J. Carr at a meeting of the North of England Institute of Mining and Mechanical Engineers on the location of concealed Whin Dyke by use of the four-electrode method of electrical prospecting appears in the *Iron and Coal Trades Review* for December 16.

Aerial Surveying.—A paper by Major C. K. Cochran-Patrick on the aerial survey is given in the *Journal* of the South African Institution of Engineers for December.

Aircraft and Petroleum Technology.—Major H. Hemming gave a lecture before the Institution of Petroleum Technologists on January 10, entitled: "Aircraft in Relation to Petroleum Technology."

Auriferous Jacutinga.—E. P. de Oliviera discusses the genesis of deposits of auriferous jacutinga in *Economic Geology* for December.

Gilsonite.—The mining of gilsonite in Utah is described by R. C. Fleming in *Mining and Metallurgy* for December.

Gold in Manitoba.—J. P. de Wet describes some Manitoba gold areas in the *Canadian Mining Journal* for December.

Wallace Mountain, B.C.—Some notes on the Wallace Mountain camp, Beaverdell, B.C., are given by A. W. Davis in the *Canadian Mining and Metallurgical Bulletin* for December.

Modern Metals.—A supplement to *Chemical and Metallurgical Engineering* for September last gave summarized particulars of a great many modern metals which have proved of use to the chemical engineer.

Bronze-Age Mining.—Extracts from a paper by O. Davies on Bronze-Age mining round the Ægean, read before the British Association on September 7 last, are given in *Nature* for December 31.

RECENT PATENTS PUBLISHED

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

21,117 of 1931 (382,311). H. N. G. COBBE, London. A system of water concentration in which travelling riffles pass over openings through which the entrapped heavier minerals are discharged.

22,625 of 1931 (380,905). G. PEMETZRIEDER, Berlin. Improvements in the centrifugal casting of metals.

23,405 of 1931 (382,348). A. BEEBY THOMPSON, London. Boring tools are provided with transverse coring apparatus, bevel-driven through the rods, by means of which core samples may be taken from the sides of the bore-hole at any depth.

23,443 of 1931 (380,912). SIMON-CARVES, LTD., Stockport, and V. H. ADAMS, Mellor. Improvements in the classification and dewatering of washed coal.

24,304 of 1931 (382,697). R. F. BACON, New York. The reaction between hydrogen, chloride, and water, in a chlorinating process for the recovery of free sulphur from metallic sulphides is found to be promoted when conducted in the presence of small amounts of water vapour, or of water vapour and oxygen.

24,849 of 1931 (382,366). ELECTRIC SMELTING AND ALUMINIUM COMPANY, Cleveland, Ohio. Particles of aluminium hydrate precipitated from an alkali metal aluminate solution are prevented by an upflow current from settling until they reach a predetermined size.

1,465 of 1932 (382,482). K. W. PALMAER, Stockholm. Electrodeposition of metals in a cell wherein a flowing mercury cathode is used.

7,492 of 1932 (383,843). B. F. MITCHELL, Auckland, New Zealand. Water concentration of minerals is carried on in apparatus incorporating a rotary screen and vibrating sluice box equipped with an endless conveyor.

12,380 of 1932 (382,884) and 14,745 of 1932 (382,901). DEUTSCHE GOLD- UND SILBER-SCHEIDEANSTALT, Frankfurt-on-Main, Germany. Processes for the treatment of precious-metal containing materials, particularly jewellers' scrap.

13,739 of 1932 (383,200). I. G. FARBENINDUSTRIE A.-G., Frankfurt-on-Main, Germany. Beryllium alloys of the heavy metals are produced by reduction of beryllium compounds in a bath of the molten heavy metal.

NEW BOOKS, PAMPHLETS, Etc.

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

A Treatise on Sedimentation. Second edition. By W. H. TWENHOFEL and collaborators. Cloth, octavo, 926 pages, illustrated. Price 58s. London: Baillière, Tindall and Cox.

Textbook of Palaeontology. Vol. 2. By KARL VON ZITTEL. Translated and edited by CHARLES R. EASTMAN. Second English edition revised, with additions, by Sir ARTHUR SMITH WOODWARD. Cloth, octavo, 464 pages, illustrated. Price 30s. London: Macmillan and Co.

Feldspar. By HUGH S. SPENCE. Paper covers, 145 pages, illustrated. Price 25 cents. Ottawa: Department of Mines.

Southern Rhodesia: The Geology of the Antelope Gold Belt. By A. E. PHAUP. Geological Survey Bulletin No. 21. Paper covers, 119 pages, illustrated, with maps. Price 3s. 3d. Salisbury: Geological Survey.

British Columbia: Lode-Gold Developments during 1932. Department of Mines Bulletin No. 3, 1932. Paper covers, 37 pages typescript. Victoria: Bureau of Mines.

Algeria: Bulletin Du Service de la Carte Géologique de l'Algérie, 4[e] Série, Géophysique, No. 1. Études Géologiques et Prospections Minières par les Méthodes Géophysiques. By P. GEOFFROY and P. CHARRIN. Paper covers, 347 pages, illustrated. Price 66 francs. Paris: Librairie Ch. Béranger.

United States Geological Survey: Director's Annual Report for the year to June 30, 1932. Paper covers, 94 pages. Price 10 cents. Washington: Superintendent of Documents.

United States Bureau of Mines: Director's Annual Report for the year to June 30, 1932. Paper covers, 30 pages. Price 5 cents. Washington: Superintendent of Documents.

Pneumatic Tabling of Coal: Effect of Specific Gravity, Size, and Shape. By H. F. YANCEY and C. B. PORTER. United States Bureau of Mines Technical Paper 536. Paper covers, 18 pages, illustrated. Price 5 cents. Washington: Superintendent of Documents.

Inflammability of Dust: Laboratory testing of the inflammability of coal and other dusts conducted by the United States Bureau of Mines. Bulletin 365. Paper covers, 45 pages, illustrated. Price 10 cents. Washington: Superintendent of Documents.

Crater Wells, Richland Gas Field, Louisiana. By H. B. HILL. United States Bureau of Mines Technical Paper 535. Paper covers, 37 pages, illustrated. Price 10 cents. Washington: Superintendent of Documents.

United States Petroleum Refinery Statistics, 1930. By G. R. HOPKINS. United States Bureau of Mines Bulletin 367. Paper covers, 104 pages, illustrated. Price 15 cents. Washington: Superintendent of Documents.

Pioche District, Nevada: Geology and Ore Deposits. By LEWIS G. WESTGATE and A. KNOPF. United States Geological Survey Professional Paper 171. Paper covers, 79 pages, illustrated, with maps. Price 85 cents. Washington: Superintendent of Documents.

Stockton and Fairfield Quadrangles, Utah: Geology and Ore Deposits. By T. GILLULY.

United States Geological Survey Professional Paper 173. Paper covers, 171 pages, illustrated, with maps. Washington: Superintendent of Documents.

Lower Rio Grande Region, Texas: Tertiary and Quaternary Geology. By A. C. Trowbridge. United States Geological Survey Bulletin 837. Paper covers, 260 pages, illustrated, with maps. Price 75 cents. Washington: Superintendent of Documents.

Mineral Resources of the United States, 1931. Summary, 110 pages, paper covers. Price 10 cents. Part I, pp. 9–16, Arsenic, Bismuth, Selenium, and Tellurium, by G. N. Gerry and H. M. Meyer; pp. 17–41, Bauxite and Aluminium, by C. E. Julihn; pp. 43-50, Tungsten, by F. L. Hess; pp. 51–69, Antimony, by P. M. Tyler. Part II, pp. 73–98, Fuller's Earth, by P. Hatmaker and J. Middleton; pp. 99–110, Talc and Soapstone, by O. Bowles and B. H. Stoddard; pp. 111–130, Abrasive Materials, by P. Hatmaker and A. E. Davis; pp. 131–158, Sulphur and Pyrites, by R. H. Ridgway; pp. 165–177, Slate, by O. Bowles and A. T. Coons. Each section price 5 cents. Washington: Superintendent of Documents.

Mining Highest and Lowest Prices, Dividends, etc., for Past Six Years. Mid-December, 1932. Paper covers, pocket size, 110 pages. Price 2s. London: Fredc. C. Mathieson and Sons.

COMPANY REPORTS

Jos Tin Area.—This company was formed in 1910 and works alluvial tin property in Northern Nigeria. The report for the year ended July 31 last shows the output of tin concentrates to have been 141½ tons, against 225 tons in the previous year, the reduction being entirely due to restriction. The concentrates realized £92 17s. per ton, as compared with £80 3s. 7d. per ton for the year 1930–31. The accounts show a profit of £5,034, which, added to the sum brought in, gave an available total of £8,262. Of this amount £4,500 was absorbed as a dividend, equal to 6%, and, after making allowance for income tax, there remained a sum of £3,638 to be carried forward.

Baba River Tin.—Formed in 1926, this company works alluvial tin property in Northern Nigeria. The report for the year to March 31 last shows an output of 46½ tons of tin concentrates, as compared with 96½ tons in the previous year, the average price realized being £69 3s. 3d. per ton, against £67 12s. 9d. Production costs have now been reduced to £51 16s. 8d. per ton of concentrates f.o.r. Nigeria. The accounts, after writing off development and other expenditure and depreciation, show a net loss of £1,245, increasing the debit balance carried forward to £9,963.

Offin River Gold.—This company was formed in 1900 and is now interested in alluvial tin property in Northern Nigeria. The report for 1931 shows the output of tin concentrates in that year to have been 44 tons, of a gross value of £3,494, the reduced tonnage being due to restriction imposed. The accounts show a loss for the year of £1,536, increasing the debit balance carried forward to £39,359.

Amari Nigeria Tin.—This company, formed in 1931, works alluvial tin property in Northern Nigeria. The report for the year to March 31 last shows that mining has had to be confined, owing to restriction, to those areas from which it could be mined most cheaply, the quota for the period having been produced at £61 per ton delivered at Gudi, a figure reduced to £45 for the current quota. The accounts show a profit for the year of £1,202, which was carried forward. The ore reserves at the end of the year were estimated to be 1,197 tons of 70% concentrates.

Tarkwa Banket West.—This company was formed in 1909 and is reopening the Obuom mine in Gold Coast Colony. The report for the year to September 30 last shows that the Obuom mine was reopened in November of the current year and satisfactory progress is said to have been made.

Ayer Hitam.—Formed in 1926 this company is working alluvial tin property in the State of Selangor, F.M.S. The report for the year to June 30 last shows that owing to restriction it was only possible to work the dredge for broken periods, operations being entirely suspended for four months. The output of tin concentrates was 675·69 tons, which realized £54,120, or £80 1s. 11d. per ton, as compared with £75 11s. 6d. per ton for the previous year. The profit for the year was £21,055, which, added to the sum brought in, gave an available total of £27,015 of this amount £18,000 was distributed as dividends, equal to 10%, leaving a balance of £9,015 to be carried forward.

Chenderiang.—Formed in 1914, this company works alluvial tin property in the State of Perak, F.M.S. The report for the year to March 31 last shows a total output, under restriction conditions, of 122 tons, obtained from the treatment of 504,000 cu. yd. of ground. The dredge was finally closed down in April last, the quota being transferred to the hydraulicking and pumping sections. After writing off £2,914 for depreciation there was a loss for the year of £1,842, increasing the debit balance carried forward to £9,236.

Hongkong Tin.—This company, formed in 1927, operates alluvial tin property in the State of Selangor, F.M.S. The report for the year to August 31 last shows that the dredge ran for 3,685 hours, treating 849,800 cu. yd. of ground and recovering 415 tons of tin concentrates. The price realized for the concentrates was £90 18s. 4d. per ton. The company's assessed quota has been fixed at 1,268 tons per annum, restriction being increased to 67% of this amount in June last. The accounts show a profit of £470, increasing the sum brought in to £8,884, which was carried forward.

Kamunting Tin Dredging.—This company was formed in 1913 to acquire alluvial tin property in the State of Perak, F.M.S., but in 1930 its interests were merged with those of Pangnga River Tin, which had properties on the west coast of Siam. The report for the year ended June 30 last shows that the output from the two areas was 1,626 tons of tin ore, worth £122,429, or an average of £75 5s. 11d. per ton. The accounts show a profit of £50,645, increasing the balance brought in to £109,503. After allowing for debenture redemption and interest there was £92,029 available, of which £31,250 was distributed as dividends, equal to 5%, leaving £60,779 to be carried forward.

Kepong Dredging.—This company was formed in 1923 and operates alluvial tin property in the State of Selangor, F.M.S. The report for the year ended June 30 last shows that operations have been confined to tribute workings, owing to the incidence of restriction. The output under these conditions was 28·34 tons from the treatment of 90,180 cu. yd. of ground. The year's working resulted in a loss of £2,716, increasing the debit balance carried forward to £4,878.

Killinghall Tin. Formed in 1929, this company works alluvial tin property in the State of Selangor, F.M.S. The report for the year to August 31 last shows that the dredge commenced operations on March 1, 1932, treating 1,264,500 cu. yd. up to the end of August and recovering 172½ tons of concentrates, which realized a gross price of £89 16s. 5d. per ton. The accounts show a net loss of £5,929, which was carried forward.

Pattani Tin.—This company was formed in 1930 and works alluvial tin property in Siam. The report for the year ended June 30 last shows that the total production from dredging and hydraulicking was 552 tons of tin concentrates, which realized an average of £76 12s. 2d. per ton, the average cost of production being £56 17s. 6d. per ton. The profit for the year was £7,922, giving, after deduction of the debit balance brought in, a credit of £6,596, from which certain expenses and commissions have been written off, leaving a balance of £5,194 to be carried forward.

Chosen Corporation.—This company was formed in 1923 and through its Japanese subsidiaries, works the Great Nurupi mine in Korea. The report for the year ended June 30 last shows the ore treated at this mine to have amounted to 117,070 tons, worth £203,946, the mine working profit totalling £87,852. The ore reserves at the Great Nurupi mine, at March 31 last, were estimated to be 101,958 tons of an average grade of 6·35 dwt. per ton, against 105,319 tons, averaging 6·51 dwt., at March 31, 1931. During the year the East Nurupi mine and the other properties were worked by tributors, but arrangements have now been made for re-opening the East Nurupi. The accounts show a profit of £19,160, making, with the sum brought in, an available total of £29,496, of which London expenses absorbed £7,836. Dividends equal to 8¼d. per share absorbed £17,187, and, after making other allowances, a balance of £1,206 was carried forward.

Foldal Copper and Sulphur.—Formed in 1906, this company works copper and sulphur mines at Foldal, Norway. The report for 1931 shows considerable improvement on that for the previous year, the working loss at the mines being £879, against £17,872. The total loss for the year was £12,579, against £28,872, the total debit carried forward now amounting to £164,987.

Zletovo Mines.—This company was formed in 1929 and is developing lead-zinc-silver properties in Southern Yugoslavia. The report for the year to September 30 last shows that mining operations during the year have been confined to the No. 1 vein at Dobrevo. The partly developed and possible ore at November 1, 1931, was estimated at 632,000 tons, averaging 15·4% lead, 3·1% zinc, and 4·6 oz. silver per ton, and, although recent development has added considerably to this tonnage, no new estimate has been made.

Cyprus and General Asbestos.—This company was formed in 1931 and works chrysotile asbestos properties at Amiandos-on-Troodos, Cyprus. The report for the year to June 30 last shows that negotiations have been practically concluded with the Government for a new mining lease for 99 years. Trading was difficult during the year under review and the accounts show a loss of £3,236.

DIVIDENDS DECLARED

Apex Mines.—6d., less tax, payable February 16.

Ashanti Goldfields.—3s., less tax, payable January 31.

Ayer Hitam.—1½d., less tax, payable Dec. 30.

Broken Hill South.—1s. (Australian currency), less tax, payable February 10.

Cam and Motor.—2s. 6d., less tax.

Chosen Corporation.—4½d., less tax.

Consolidated African Selection Trust.—9d., less tax, payable February 4.

Kamunting.—2%, less tax.

Kramat Tin.—6d., less tax, payable Dec. 21.

Natal Navigation.—6d., less tax.

Rezende.—2s. 6d., less tax.

Sherwood Starr.—9d., less tax.

South African Coal Estates.—6d. (South African currency), less tax.

Tehidy Minerals.—4½d., less tax, payable January 4.

Transvaal Consolidated Land.—6d., less tax, payable December 17.

Tronoh Mines.—1½d., less tax, payable December 31.

Wanderer.—1s., less tax, payable January 1.

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

NEW COMPANIES REGISTERED

Abyssinian Mining.—Registered as a private company. Capital: £4.000 in £1 shares. Objects: To acquire mining rights or oil-bearing lands in Abyssinia. Directors: E. L. Burgin and H. T. Fraser. Office: 3, Gray's Inn Place, Gray's Inn, W.C. 1.

Anglo-Persian Oil (South Africa).—Registered as a private company. Capital: £5,000 in £1 shares. Objects: To carry on the business of producing, refining, and distributing petroleum and other oils.

General Asbestos Company.—Capital: £75,000 in 1s. shares. Objects: Incorporated in Southern Rhodesia on September 1 to acquire from Asbestos and Holdings Trust the asbestos properties, plant, machinery, buildings, etc., which were the properties of the Asbestos and General Trust. British address: Salisbury House, London Wall, E.C. 2. Directors: E. Dutchman, E. S. Robinson, and B. H. O. Armstrong, and W. Stenhouse, of Salisbury, Southern Rhodesia.

National Alloys.—Registered as a private company. Capital: £5,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in alloys of metals of all kinds, and in particular alloys of zinc, etc.

Seneca-Lebel Gold Mines.—Incorporated in Ontario on January 1, 1928. Capital: $2,000,000 in $1 shares. Objects: To acquire and work mines, mineral lands, etc. British address: 14, King William Street, E.C. 4. Directors: G. Jaffray and C. Mott, of Toronto; R. Keemle, of Worthington, Ontario; W. Fowler, of Guelph, Ontario; J. Patterson, Brighton, Sussex.

Tanami (Australia) Gold Mining Syndicate.—Registered as a public company. Capital: £10,000 in 1s. shares. Office: 20, Copthall Avenue, E.C. 2.

United Goldfields of Guiana.—Registered as a public company. Capital: £35,000 in 30,000 Ordinary shares of 10s. each, and 20,000 10 per cent. Preference shares of £1 each. Objects: To acquire and develop mines, estates, and forests, etc.