The Mining Magazine

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EDITORIAL

THE New Year Honours List contains but two names of interest to our readers, Dr. Harold Moore, Director of Metallurgical Research, War Office, and Mr. G. K. Menzies, Secretary of the Royal Society of Arts, each receiving the C.B.E.

IN view of the prevailing disturbed economic and financial conditions, the Council of the Institute of Metals has decided to postpone the 1932 meeting, which was to have been held in the United States and Canada in the Autumn.

DR. C. H. MATHEWSON, of Yale University, has been nominated James Douglas medallist of the American Institute of Mining and Metallurgical Engineers for 1932. The award is in recognition of "his scientific contributions to the art of working and annealing non-ferrous metals."

THE new Secretary-Treasurer of the Canadian Institute of Mining and Metallurgy is Mr. E. J. Carlyle, who is well-known to many on this side. Mr. Carlyle has had extensive professional experience, which should prove invaluable at a time when depression is seriously affecting mining affairs.

A DESCRIPTION of the new ore-dressing laboratory at Birmingham University appeared in the last issue of the MAGAZINE. The new building was opened by Sir Robert Horne on December 16, those present subsequently having the opportunity of examining the admirable facilities available at this University for the training of students, particularly in the mining of coal. After a ceremonial luncheon, Sir Robert Horne and Mr. Evan Williams received honorary degrees at the hands of the Vice-Chancellor, Sir Charles Grant Robertson.

THE president-elect of the Institution of Mining and Metallurgy for 1932–33 is Dr. Sydney W. Smith. Dr. Smith, who graduated from the Royal School of Mines in metallurgy in 1899, is a D.Sc. of London University, a Member of the Institute of Metals, a Fellow of the Institute of Chemistry, and a Fellow of the Chemical Society. He has been a Member of the Institution since 1908 and a Vice-President since 1929 and in 1926 was awarded the Gold Medal of the Consolidated Gold Fields of South Africa, Ltd. On the occasion of the Empire Mining and Metallurgical Congress in South Africa in 1930—in connexion with which Dr. Smith contributed a series of articles to THE MINING MAGAZINE—the new president was made an Honorary D.Sc. of the University of the Witwatersrand. Dr. Smith commenced professional work in 1899 as assistant to the late Sir William Roberts-Austen in connexion with the work of the Alloys Research Committee of the Institution of Mechanical Engineers. He was appointed Temporary Assistant Assayer at the Royal Mint in 1900 and passed through the position of Assistant Assayer to that of Chief Assayer, which he has held since 1926.

Gold and Silver

The December meeting of the Institution is not usually one of the best attended, members generally having so many seasonable calls on their time, so that the large number present at last month's gathering evidenced the keen interest aroused by the paper to be discussed—"Gold and Silver as Money Metal," by Mr. T. A. Rickard. Several distinguished guests were also present and the interest displayed serves to emphasize the anxiety of all to help in the correction of those failings of present-day economics, which are generally regarded as the major cause of the prevailing depression. The subject under discussion dealt not only with money, but with gold and silver, two metals of such importance to all mining engineers that even those who professed to know nothing of monetary theory could at least feel that the matter had an intimate bearing on their own immediate problem, that of growing unemployment.

It may be said at once that Mr. Rickard's paper is a plea for the re-establishment of a bimetallic monetary standard by the restoration of silver to a place in partnership with gold. He states that the adoption of the gold standard was generally accepted in the belief that stability of international

price levels would ensue and that this belief has turned out to be false. Prior to the adoption of the monometallic basis for international exchange purposes bimetallism is said to have functioned satisfactorily, but the discoveries of silver in the western United States some sixty years ago caused a scare which drove most of the important powers on to the gold standard, silver being retained by some of these for use in subsidiary coinage only. Mr. Rickard regards as baseless the panic which caused these hasty abandonments of bimetallic currency and states that the demonetization of silver during this period can find no justification in the statistics of mining. As is usual in all surveys of metallic money standards and their bearing on present conditions in world trade, the author stresses the importance of relations with those eastern nations whose affairs are still intimately associated with silver—chiefly China, which is still on a silver standard, and India, which, while on a gold-exchange standard, has so much hoarded wealth in the form of silver metal. Mr. Rickard is not alone in considering that the gold standard has tended to demoralize eastern markets for western products and he urges the adoption of speedy measures to counteract such an impossible position, proposing the setting up of a bimetallic standard based on a ratio of gold to silver at 1 : 15 as being the one step most likely to lead to improvement. Finally, the paper lays stress on the fact that bimetallism is nothing that is new and emphasizes the view that its readoption would only be a return to a well-tried monetary system.

In introducing Mr. Rickard's paper the president—Mr. Pellew-Harvey—showed the importance of silver prices to base-metal producers and held this to be a justification for the examination by all mining engineers of what might otherwise be considered as purely a question for economists. He, too, laid stress on relations with eastern peoples, agreeing whole-heartedly with the author's view that the deterioration of eastern trade might justly be considered as closely related with the fall in silver prices. After considering various schemes which have been advanced for the rehabilitation of silver metal, Mr. Pellew-Harvey reminded those present that the Institution in seeking to ventilate the matter should approach it from a national and not a selfish standpoint. The paper was then briefly but adequately introduced by the author and thrown open to discussion, the first speaker being Mr. J. A. Agnew, who immediately threw his weight on the side of the bimetallists, laying equal emphasis with the author on the likely effect of such a step on the restoration of eastern trade. Mr. Agnew was followed by Sir Henry Strakosch, who, by means of carefully prepared statistics, urged that it was too early to say that gold had failed the world, and demonstrated that bimetallism could not in the least have prevented the flow of bullion to the great creditor nations, France and the United States, and, turning to statistics once again, held that conditions within China and India were really not so bad after all, although their external trade was without doubt limited by silver prices. Mr. F. H. Hamilton, in his contribution to the discussion, pointed out the unfortunate effect of the stabilization of the rupee at 1s. 6d. and Col. F. L. Harden, who followed and who was very much a bimetallist, in his enthusiasm clearly had much of the meeting with him. Other speakers included Mr. Gilman Brown and Mr. Cull, the latter taking the view that synmetallism had yet to be proved unworkable.

The result of the evening's discussion leaves matters pretty much where they were. The subject remains an extremely debateable one, it not being difficult to produce arguments for and against such a step as is advocated in the paper. The world's production of gold can hardly hope to keep pace with the growing needs of commerce, so that some step must be taken sooner or later in an endeavour to restore price levels to an equitable basis. The adoption of bimetallism would, at least, be something concrete, it is apparently easy, and, as the author has said, it has been tried. It is doubtful, however, whether international agreement on the adoption of a bimetal standard would be easy of achievement—in fact, in view of the uncontrollability of silver supplies, it might almost be called impossible, for a dual standard calls for perfect price substitution of one metal standard for the other. Here appears to be the crux of the problem : Could an international agreement on the price ratio of gold to silver counteract the natural price ratio created by production costs ? Bimetallists and monometallists will doubtless answer this question to their own satisfaction ; we fear we cannot answer it for them.

Metals in 1931

The course of prices of the leading non-ferrous metals during 1931 proved a severe disappointment, not only to the producers, but to the various big syndicates and groups desirous of controlling markets. Prices generally fell to the lowest level for many years and copper and spelter broke all records. The unsatisfactory results attending the efforts of the Copper Producers to capture world trade have been approached only by the confusion created by the speculative groups engaged for a very long period in manipulating tin, but in the latter case the Governments concerned eventually came to the rescue and, by enforcing drastic cuts in production and encouraging the speculative operations of the International Tin Pool, the decline in prices was checked. In the middle of last year tin changed hands in the neighbourhood of £100 and the subsequent advance to over £140 appears impressive until it is remembered that the improvement is largely due to the fall in sterling. Lead, of course, is closely controlled by the organization of producers, as, too, is spelter. Broadly speaking, all the main non-ferrous metals are today controlled, more or less, and should therefore be in a technical position to respond to any favourable development in trade, but the world-wide chaos involved by the Reparations futilities has paralysed the channels provided for the international exchange of commodities, which makes the future somewhat obscure.

Taking the metals separately, the copper industry went from bad to worse last year. In Micawber-like fashion the producers carried on, trusting that something would turn up to rectify a situation that was steadily becoming almost hopeless. When the year opened the refined copper stocks in America amounted to some 367,000 short tons, but by the end of the year the estimate had soared to 550,000 tons. The official monthly figures of American output, deliveries, and stocks were suspended in the Autumn and negotiations which took place from time to time failed to result in any agreement which might have helped to remedy the situation. World output trended gradually downwards under economic pressure, but there was actually a slight increase in America in the middle of the year, although later the producers there began to cut operations quite substantially. At the eleventh hour, when Copper Exporters looked like breaking-up, some 90 per cent. of the world's producers agreed to cut down their operations during 1932 to 40 per cent. of their capacity, estimated at 2,250,000 tons. Drastic as this curtailment is, it is somewhat doubtful whether it will be sufficient to reduce stocks at the desired rate.

During 1931 tin history is very largely a story of the progress of the quota scheme of the Governments concerned. After months of negotiation and the failure of the schemes for voluntary curtailment of output, the compulsory plan was enforced from March 1 by legislation in Malaya, Nigeria, Bolivia, and the Dutch East Indies, whose aggregate annual output was limited to 125,845 tons. From June 1 this figure was reduced further to 106,096 tons, whilst from September 1, with the inclusion of Siam in the scheme, it rose to 116,096 tons, subsequently falling to 101,096 tons, operative from January 1, 1932. The enforcement of this scheme, particularly in the early stages, was accompanied by much confusion and, with consumption declining steadily, the visible supply—including the carry-over in the East—rose over 13,000 tons during the year. Demand fell so severely that world production has now been reduced some 40 per cent. from the 1929 level. In August an International Pool was formed to acquire surplus stocks of tin up to a maximum of about 25,000 tons, of which at the moment it holds some 19,000 tons, but none of this may be liquidated until the price averages £165 throughout one calendar month. With the Governments in the quota scheme pledged to maintain the restrictions until August, 1934, if necessary, in order to facilitate the liquidation of the Pool's stocks, and with production curtailed drastically, tin values should improve, but the international situation is so difficult that even now the immediate outlook is uncertain.

Viewed in comparison with the other major non-ferrous metals, lead suffered less from the depression last year, but 1931 was anything but a good period for producers. The slump in silver affected the lead industry adversely and with consumption well below recent levels, especially on the Continent and in America, over-production was seen, accompanied by falling prices. To rectify this the Lead Producers' Association inaugurated a 15 per cent. cut in output on May 1, increasing the curtailment to 20 per cent. from July 1. With a spell of buying here following the suspension of the

gold standard the market preserved a pretty steady tone in the closing months of the year and with a strong control of supplies and stocks is in a position to take advantage of any improvement in general conditions.

Of all the groups of producers still endeavouring to control non-ferrous metals the new Zinc Cartel, which fructified during 1931, has probably been the most successful. The continued economic crisis gave spelter makers two alternatives—either to let competition take its unrestricted course and force the dearer-cost producers out of existence or to combine amongst themselves and regulate output. The latter course was adopted in July, when the Cartel was formed, and in August output was reduced to 55 per cent. of the 1927–1930 basis. The Cartel's stocks began at once to fall, receding from 228,000 tons in June to 186,000 tons in December. Consumption has been unsatisfactory, but producers are getting the situation under control, although there exist further large stocks in America not under direct Cartel control.

Faraday and Metallurgy

The centenary celebrations held in London last year to mark what was undoubtedly the most important discovery of Michael Faraday —that of electro-magnetic induction—served to bring light on many of his activities which were to most people almost unknown. At the British Association meeting Sir Robert Hadfield surveyed Faraday's metallurgical work in a paper which was essentially a summary of work presented earlier before the Royal Society,[1] a notice of which appeared in the MAGAZINE for October last. This aspect of Faraday's life has now been brought home to a wider public in still greater detail by Sir Robert's new book,[2] which contains the results of work on additional material and goes much farther, tracing the influence of those whose discoveries aided Faraday or whose part was that of active assistants.

As has been indicated, the scope of this illuminating book is very wide, containing all the elements of carefully completed biographical research, in addition to a thorough survey, by modern chemical means, of the metallurgical work itself. After tracing Faraday's rise to fame, Sir Robert assists the reader to gain some idea of the conditions under which the great experimenter worked, showing something of the influences which guided his metallurgical studies. This section of the book, besides presenting an admirable summary of times and people, is rendered much more valuable by a collection of portraits of the persons concerned, with the exception of that of Stodart, whose assistance in practical steel work was of such help to Faraday. Passing to the events of the six years, 1819–1824, which were devoted to this work, it is shown that the investigations can be conveniently grouped under five headings: First, the examination of wootz steel, which formed the subject of a paper before the Royal Institution in 1819; secondly, a series of experiments on alloy steels, described in his 1820 paper to the same body; thirdly, the events leading to the Royal Society paper of 1822, "On the Alloys of Steel"; fourthly, the large-scale experiments at Sanderson's, Sheffield, and, finally, the period of research covering "The Magnetic Relation and Character of the Metals." The author then goes on to show that Faraday's work on steel and alloys may justly be regarded as the beginning of systematic work on alloy steels, even if it was not to lead immediately to a period of practical utilization of his results. The next part of the book covers a modern investigation of Faraday's specimens and is a record of detailed, thoroughly-scientific research work. Finally, Sir Robert has written an appreciation of Faraday's work before suitably concluding with an outline of the later development of alloy steels.

To understand just what Faraday had accomplished it is necessary to turn once again to Sir Robert's "Appreciation." During the few years he was able to devote to this branch of his researches Faraday carried out systematic work on the alloys of steel with platinum, silver, rhodium, and nickel and he was the first to attempt the manufacture of a stainless steel by alloying iron and other metals. It is true that the work was of little industrial use at the time, which explains much of the unfavourable comment which has been made upon it, but it is remarkable that the research should have anticipated in so many ways the investigations of later workers. Who knows, had Faraday been in the position to try manganese in his work, whether he might not have forestalled Sir Robert's own important invention!

[1] *Phil. Trans.*, A, vol. ccxxx, September, 1931.
[2] "Faraday and His Metallurgical Researches." By Sir Robert Hadfield, Bart. Price 21s. London: Chapman and Hall.

REVIEW OF MINING

Introduction.—The old year has passed, to the accompaniment of a general sigh of relief. As it is felt in many quarters that things must have now touched bottom, hopes are entertained of at any rate some improvement during 1932.

Transvaal.—The output of gold on the Rand for December was 877,178 oz. and in outside districts 46,175 oz., making a total of 923,353 oz., as compared with 900,510 oz. in November. Last year's total of 10,874,145 oz. constitutes a fresh record, being 154,385 oz. ahead of the figures for 1930. The number of natives employed on the gold mines at the end of the month totalled 211,552 as compared with 209,270 at the end of November.

The accompanying table gives the dividends declared by the Rand gold mining companies on account of the past half-year. For the purpose of comparison the figures for the preceding three half-years are given and from these it will be seen that Geduld and Sub Nigel are the only companies to show an increase, although Rose Deep, East Rand, and Randfontein reappear in the list. The figures for the past half-year are, of course, in South African currency:

	1st half, 1930.	2nd half, 1930.	1st half, 1931.	2nd half, 1931.
	s. d.	s. d.	s. d.	s. d.
Brakpan	4 3	4 6	4 0	4 0
Consolidated Main Reef	0 9	1 3	1 3	1 3
Crown	3 3	3 6	3 6	3 6
Durban Roodepoort Deep	0 3	0 6	0 9	0 9
East Rand	—	—	—	0 6
Geduld	3 3	3 3	3 3	3 6
Geldenhuis Deep	0 9	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
Modderfontein B	2 0	2 0	1 6	1 6
Modderfontein Deep	3 3	3 3	3 0	3 0
Modderfontein East	2 0	2 0	2 0	2 0
New Modderfontein	6 9	6 6	6 0	5 6
New State Areas	1 6	2 0	2 0	2 0
Nourse Mines	0 6	0 9	0 9	0 9
Randfontein	—	—	—	0 6
Robinson Deep (A 1s.)	1 6	1 6	1 6	1 6
Robinson Deep (B)	—	7½	4½	0 6
Rose Deep	0 6	0 6	—	0 6
Springs Mines	3 6	4 0	3 9	4 0
Sub Nigel	2 0	3 0	3 0	3 6
Van Ryn Deep	3 0	3 0	2 6	2 6
West Springs	1 0	1 0	0 9	0 9
Witwatersrand Gold	1 0	1 0	0 6	0 6

Shareholders of the Johannesburg Consolidated Investment Company have been informed that, although the profits earned for the half-year to December 31 last justify a distribution, it has been decided, in view of the prevailing financial conditions, not to declare an interim dividend.

For the purpose of providing additional funds to cover expenditure on capital account, the board of East Geduld Mines has decided to issue a further 60,000 shares. This new issue has been made under the terms of the existing agreement with the Union Corporation, whereby that company holds a preferential right to subscribe at par. The capital of East Geduld has, consequently, been increased to £1,560,000.

It is reported from South Africa that negotiations are proceeding for the acquisition of the Witpoort Gold Areas by Brakpan Mines. It will be recalled that development operations at the Witpoort mine were suspended in November last, owing to lack of funds.

Control of New Albion Transvaal Gold Mines has been acquired by Oceana Development, which has purchased approximately 51% of the New Albion capital. It is stated that the purchase consideration has been discharged without materially affecting the company's liquid resources.

Elsewhere in this issue will be found the registration of a new company, which has taken over H.E. Proprietary (New). This step forms part of a scheme for reconstruction which was unanimously approved at an extraordinary meeting held last month.

The accounts of Potgietersrust Platinums for the 11 months to August 31 last show that the loss carried forward has been increased by £15,106 to £76,232. During the period under review work was concentrated on the Klipfontein and Kroondal portions of the Rustenberg section, while 19,951 oz. of platinum group metals and gold was produced. As was announced in the MAGAZINE for August last, the mines of Potgietersrust Platinums were taken over by a new company, Rustenberg Platinum Mines, on September 1, 1931, the former company receiving 262,491 first preference shares of £1 each in the new company.

The accounts of African Asbestos Trust for the year to June 30 last show that the value of asbestos sold, together with sundry revenue, totalled £2,036, against £5,423 the

previous year, and expenses amounted to £1,550. It is stated that the board has found it impossible to raise the further capital necessary to reopen the mine and to install the main plant.

Diamonds.—The accounts of De Beers Consolidated Mines, Ltd., for the year ended June 30 last show the stocks of blue ground on the floors at the end of the year to be 2,141,952 loads, of which 48,396 came from the De Beers mine, 344,332 from the Wesselton mine, 822,779 from the Bultfontein mine, and 926,445 from the Dutoitspan mine. The diamond account for the year amounted to £679,553 and income from other sources to £750,244, giving, with the sum brought in, a total of £2,831,516. Expenses amounted to £1,296,053, leaving a balance of £1,535,463, of which £400,000 was paid as preference dividends, the sum of £1,135,463 being carried forward.

Southern Rhodesia.—The output of gold from Southern Rhodesia during November was 44,516 oz., as compared with 44,260 oz. for the previous month and 44,351 oz. in November, 1931. Other outputs for November were: Silver, 7,858 oz.; coal, 51,644 tons; chrome ore, 10,612 tons; asbestos, 553 tons; mica, 9 tons.

At an extraordinary meeting held last month shareholders of Mapeke Asbestos Mines agreed to the voluntary winding up of the company, the assets of which are to be sold to a new company with a similar name.

Advice from South Africa is to the effect that the Globe and Phœnix Company has obtained leave to appeal against the order recently made in the High Court giving the right of inspection to the Rhodesian Corporation.

Northern Rhodesia.—The report of Mufulira Copper Mines for the three months ended September 30 last shows development work at the mine to have been making steady progress, while construction work has also proceeded rapidly. It is anticipated that the plant will be completed and ready to go into operation some time this month.

During the year ended June 30 last geological work was continued by Rhodesia Minerals Concession, Ltd., but none of the prospects on which this was done proved of any value. The extent and character of the area, however, are stated to be so promising that the work is to be continued.

Gold Coast.—Shareholders of Ashanti Goldfields Corporation, Ltd., have been informed that a final dividend of 40% has been recommended for the year ended September 30 last, making a total of 90% for the year. In addition, it is once again proposed to capitalize £125,000 of the reserve, distributing the 625,000 shares thus created as fully paid bonus shares to the shareholders in the proportion of one share for every three held.

The report of Bibiani (1927) shows that expenditure on shaft sinking, etc., for the year to June 30 last amounted to £30,851, while £2,473 was spent on plant and machinery. The report of the consulting engineer, Mr. J. S. Watkins, shows that the state of affairs at the mine is held to be promising and he recommends not only the continuance of prospecting and development work, but the erection of a treatment plant to deal with 100 tons per day. The company hopes to carry out these recommendations and is considering the provision of new capital for the purpose.

During the year ended September 30 last Ariston Gold Mines (1929) made a profit of £502, the debit balance at the end of 1930 having been written off in accordance with the terms of the reorganization of capital recorded in the MAGAZINE in January, 1931. Ore mined during the period under review amounted to 52,681 tons, 51,626 tons, of an average value of 10·74 dwt., being milled for a recovery of 8·66 dwt. per ton. Ore reserves at the end of the year were estimated to be 161,076 tons, averaging 11·68 dwt. in value. The mine is now under new management, which has abandoned shrinkage stoping as a costly failure and instituted a filling method. It was visited recently by Mr. C. B. Brodigan, who, in anticipation of his report, states that he can see no reason why the mine should not be working on a profit-earning basis in the near future.

The report of Morkwa, Ltd., for the year to June 30 last shows that general conditions have precluded the company from making any fresh developments, although certificates of validity of title to all its diamondiferous properties have now been obtained from the Supreme Court of the Gold Coast Colony.

Australia.—The report of the Wiluna Gold Corporation for the year ended March 31 last shows that work at the Wiluna Gold Mines during this period consisted mainly in completing the installation and erection of plant and in preparation for the stoping of ore, treatment commencing in March. By the end of October 165,709 tons of ore

had been treated, bullion worth £271,165 being recovered, working costs over the same period amounting to £167,129. Although difficulties were experienced with the power plant at first, all the equipment is now said to be working satisfactorily. Ore available for stoping at the end of the year was estimated to be 540,000 tons, assaying 33s. 6d. per ton, with, in addition, 125,000 tons of probable ore below the 450 ft. level. While recoveries in the cyanide plant have been satisfactory, certain alterations in the flotation plant have been suggested by Mr. T. Owen, who accompanied Mr. C. O. Lindberg in his examination of the property, and it is expected that these will considerably improve recovery.

Burma.—During the year 1930 the operations of Mawchi Mines, Ltd., showed a loss of £45,219, owing to the low prices prevailing for metals. By means of a reorganization of capital, announced in the MAGAZINE for July last, this loss has been written off. During the year under review alterations and additions to the mill gave considerably improved results, milling being restarted in February, 1930, and 42,741 tons treated by the end of the year. The concentrates recovered amounted to 2,018 tons, while 169 tons was purchased from native workers. At December 31, 1930, the proved ore reserves were estimated to be 123,047 tons, of an average value of 4·35% combined tin and wolfram. The cessation of development early in 1930 caused this figure to fall to 77,855 tons at the end of September last and development may soon be resumed.

Malaya.—The report of Kay Yew (Kinta Valley) Tin Mines for the year 1930 shows that 274 tons of tin concentrates was produced, which realized £87 2s. 1d. per ton, operations resulting in a loss of £5,709. In the current year many drastic economies have been made in an endeavour to carry on and 100 tons of tin concentrates was produced by September 30, when the mine was temporarily closed down, production restarting on December 1 last. Proposals for the reorganization of the company's capital are under consideration.

At a meeting of Teja Malaya Tin Dredging last month a resolution for winding up the company and appointing a receiver was approved.

China.—The accounts of the Chinese Engineering and Mining Company for the year to June 30 last show that the profit of the Kailan Mining Administration amounted to $4,064,030, the amount due to the company being $2,363,294. The reduced profit is due to a restricted output of coal caused by trouble with the Peiping-Liaoning railway, the sales at 4,500,000 tons showing a reduction of 251,000 tons compared with the previous year. The profit of the company for the year was £142,153, the balance available being £146,041. Income tax absorbed £98,098, leaving £47,942 for distribution. By bringing in £2,500 from reserve, a dividend of 2½% was paid, absorbing £49,000, and a balance of £1,442 carried forward.

Panama. — Shareholders of Panama Corporation have been informed of developments in the El Mineral district at Margaja, where a lode intersected at 80 ft. below the surface assays $92 over 36 in. The same lode 13,000 ft. away assays $108 over 27 in. It was subsequently announced that in view of developments on the company's properties the annual report has had to be postponed until February.

Bolivia.—At a special meeting of Patino Mines and Enterprises to be held this month it will be proposed that the company should acquire in exchange for shares not less than 90% of the capital of Sociedad Empresa de Estano de Araca.

Mexico.—At a meeting of Esperanza, Ltd., held this month it was resolved that the company should go into liquidation.

Spain.—Shareholders of Tigon Mining and Finance Corporation were informed last month that three units for treating ore have now been constructed at the Spanish properties and four others are to be built. It is stated that the product finds a ready sale locally. In Chile recent inroads into stocks have made it necessary to prepare for an early resumption of sulphur production. It is stated that the cash resources of the company are ample to cover the programme on hand

Yugoslavia. — At an extraordinary meeting held last month it was resolved that the capital of Zletovo Mines be increased to £185,000 by the creation of 140,000 new 5s. shares.

Russo-Asiatic Consolidated. — The accounts of Russo-Asiatic Consolidated for the year to September 30 last show a profit of £584, the debit balance carried forward being reduced to £1,469. The position as regards the Russian interests of the company are held to be much as they were a year ago.

UGANDA

By E. J. WAYLAND, A.R.C.Sc., M.I.M.M., F.G.S.

The author, who is Director of the Geological Survey of Uganda, gives an account of the geology of the Protectorate in relation to mineral deposits and water supply.

INTRODUCTION. — Uganda is a British Protectorate bordered on the north-east and on the west by rift valleys, and on the south-east by Lake Victoria, an immense fresh-water lake comparable in area with Scotland, and situated on the plateau of east-central Africa. The Protectorate is divided into four provinces : the Eastern Province, with head quarters at Jinja, and district headquarters at Jinja, Mbale, Bubulu (south-east Elgon), Soroti, Lira, Kitgum, and Moroto ; Buganda Province (Uganda proper) with headquarters at Kampala and district headquarters at Kampala, Entebbe, Masaka, and Mubendi ; the Western Province with headquarters at Fort Portal and district headquarters at Fort Portal, Mbarara, and Kegezi ; and the Northern Province with headquarters at Masindi, and district headquarters at Masindi, Hoima, Arua, and Gulu.

The country forms part of the Great African peneplain, the development of which in this area, in spite of the existence of a few residual hills, had reached a very high stage of perfection before elevation to form the present plateau subjected it to the gouging action of consequent streams, whereby it was dissected into a number of flat-topped hills. These hills, separated by wide papyrus-choked swamps, or more or less dry, flat-bottomed valleys, are highly typical of the scenery of Uganda proper ; but the rifts, the upthrust mass of Ruwenzori and the volcanoes have a grandeur of their own, and the more northern parts of the territory are represented by a relatively low-lying plain supporting rather short grass and scattered bush.

Uganda is essentially open country. About 2% of the area only is under dense forest. What forests there are tend to occur near the lakes, on the islands in Lake Victoria, and on the mountains. Linear patches of forest occur in a number of the stream-bearing valleys and they are in many places separated by savannah, which also tends to occupy broad, flat, dry valleys that have recently been swamps. The central portions of the country, except where artificially cleared, are densely covered with elephant grass which grows to more than twice the height of a man. Much of the south-west is almost bare of vegetation, except for short grass on the hills and papyrus in the valleys.

The highest general level of the Protectorate is in the south-west, where the average altitude exceeds 5,000 ft., and much of the area lies above 6,000 ft. The lowest general level is in the north-east where, except for a fringing of relatively elevated land exceeding 4,000 ft. and rising in places to much greater heights, the average altitude is not much above 3,000 ft. The highest point of the Protectorate is Margherita Peak (16,794 ft.) on Mt. Ruwenzori, while the lowest is on the Nile near Nimule (1,930 ft.) where it passes into the Sudan by way of a sudden bend and a remarkable S.E.–N.W. stretch. The marked tendency is for the highest country to border the rifts. Ruwenzori, which is almost surrounded by rifts, is the only mountain in Uganda that has a permanent snow and glacier field. The volcanoes of Bufumbira (Muhavura 13,547 ft., Sabinyo 11,960 ft., and Mgahinga 11,400 ft.), to the south of Ruwenzori, are part of the great Birunga volcanic area that lies athwart the western rift ; and Mt. Elgon, another volcano (14,178 ft.), borders the eastern rift, which is in Kenya.

The mean annual rainfall of the Protectorate varies from less than 25 in. in Karamoja (N.E. Uganda) to about 80 in the Sese Islands. On Ruwenzori it is recorded as 65 or more, and on Elgon about 70 in.

The lakes of Uganda are all remarkable ; they have had unusual histories, and all may be said to owe their origin to secular disturbance. Lake Victoria (26,828 sq. miles, altitude 3,726 ft.) lies in a relative downwarp, or subsidence ; Lakes Albert (area 2,064 sq. miles, altitude 2,028 ft.), Edward (area 830 sq. miles, altitude 3,000 ft.), and George (area 114 sq. miles, altitude 3,015 ft.), are all in the western rift valley ; while Kioga (area about 2,000 sq. miles, altitude 3,376 ft.), almost unique among lakes, is a drowned valley system ; and there are other, but smaller examples of this type of reservoir (Fig. 2). In the volcanic area of the extreme south-west of the Protectorate there are a number of lakes that, as A. D. Combe has shown, owe their origin to the

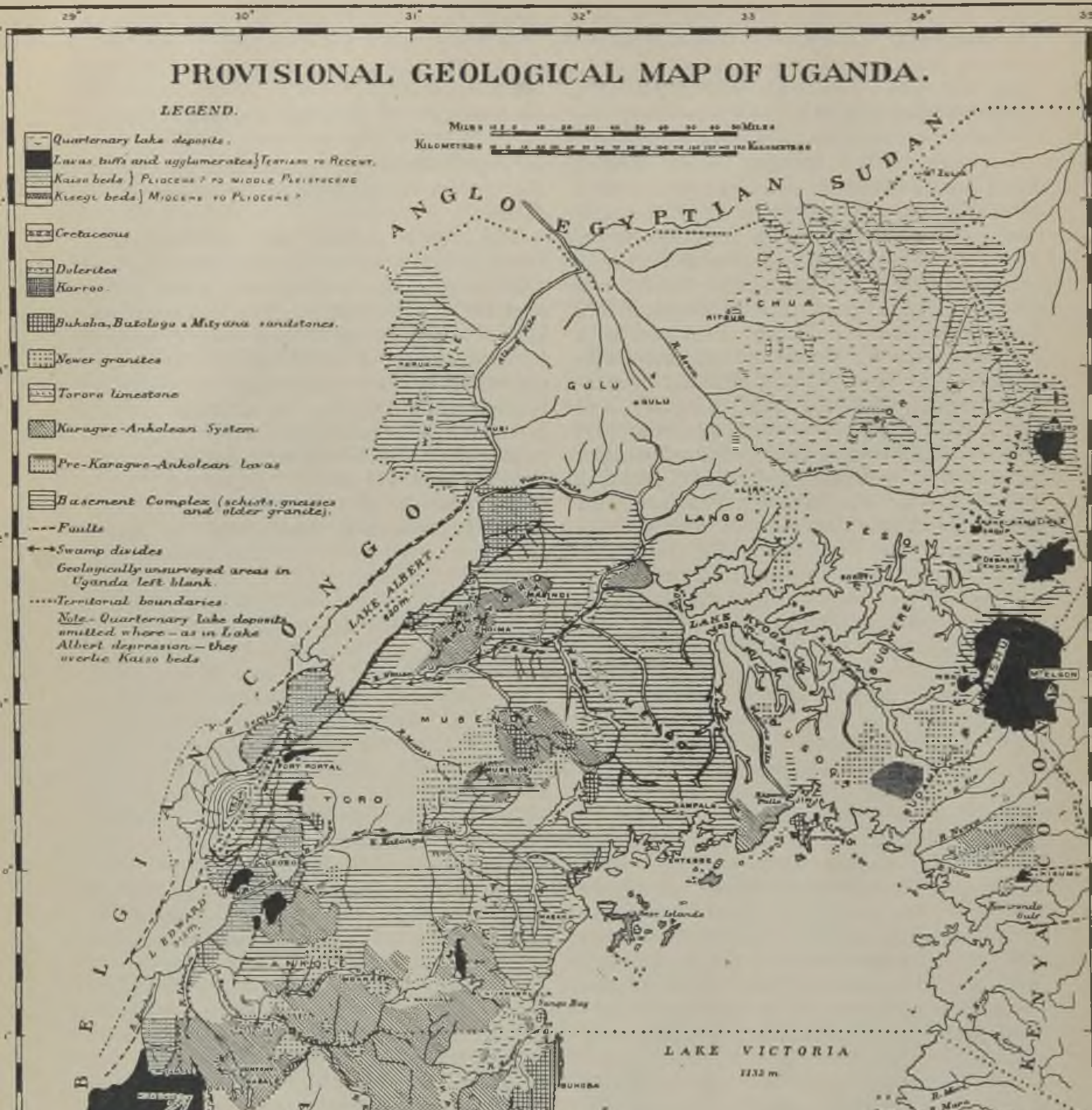

PROVISIONAL GEOLOGICAL MAP OF UGANDA.
LEGEND.
Quarternary lake deposits.
Lavas tuffs and agglomerates } Tertiary to Recent.
Kaiso beds } Pliocene ? to middle Pleistocene
Kisegi beds } Miocene to Pliocene ?
Cretaceous
Dolerites
Karroo.
Bukoba, Butologo & Mityana sandstones.
Newer granites
Tororo limestone
Karagwe-Ankolean System.
Pre-Karagwe-Ankolean lavas
Basement Complex (schists, gneisses and older granite).
Faults
Swamp divides
Geologically unsurveyed areas in Uganda left blank.
Territorial boundaries.
Note.—Quarternary lake deposits omitted where—as in Lake Albert depression—they overlie Kaiso beds
ANGLO EGYPTIAN SUDAN
BELGIAN CONGO
KENYA COLONY
TANGANYIKA TERRITORY
RUANDA
LAKE ALBERT
LAKE EDWARD
LAKE KYOGA
LAKE VICTORIA
GULU
LANGO
TORO
MUBENDE
ANKOLE
KAMPALA
MT ELGON

FIG. 1.

FIG. 2.—LAKE NAKAVALI—A TYPICAL SWAMP LAKE FORMED IN A DROWNED EROSION VALLEY, LARGELY FILLED WITH PAPYRUS AT THE PRESENT DAY.

damming of erosion valleys by lava flows (Fig. 3).

GEOLOGY AND MINERALS.—It is not enough to say that Uganda is part of the great African table-land, for a study of the plateaux shows that these do not represent a single great erosion-cut surface, but three such surfaces, three peneplains in fact, now elevated to form the tabled uplands of Central Africa. Though all may be present in an area, the highest and oldest of these is best seen in Ankole, the middle and younger is typically developed in Buganda, particularly Eastern Buganda, and the third and youngest in the northern and north-eastern parts of the Protectorate. Economically

FIG. 3.—LAKE BUNYONYI—FORMED IN AN EROSION VALLEY DAMMED BY A LAVA-FLOW, WHICH OCCUPIES THE FOREGROUND.

they are extremely important, and they will be considered at greater length later. They cut across all the solid rocks except the later volcanics (Fig. 14).

The distribution of the various members of the stratigraphical groups present will easily be seen from the accompanying map (Fig. 1). A few words about each of these will be necessary.

The *Basement Complex* consists of the usual assemblage of gneisses, schists, quartzites, and occasional limestones, and does not call for any special description here (Figs. 4 and 5). It is, in part at any rate, a highly metamorphosed sedimentary series of vast antiquity, and is apparently intruded by a charnockite series, strikingly similar to that of India. Research upon these rocks is proceeding. The Complex is, of course, pierced by all the various subsequent intrusives, including the highly important Newer Granites, and the dolerites, many of which are probably of Karroo age. Apart from some valuable limestones and magnetite deposits in and derived from the limestones, no minerals of economic importance are, at present, definitely known to occur in the rocks of the Complex, except in Ruwenzori, where copper ores and galena have been introduced into them by later intrusion.

At Kilembe (N. 0° 12′, E. 0° 30′, approx.), in a small tributary valley of the Namwamba River, on the south-east of Ruwenzori, Tanganyika Concessions, Ltd., are developing a promising copper deposit. The copper minerals known to occur there are chalcopyrite, chalcocite, chalcanthite, and cupriferous pyrite, in the unweathered or but little weathered rocks; and malachite, azurite, chrysocolla, melaconite, and cuprite in the oxidized zone. The country rocks are metamorphic. The majority are hornfelses consisting, for the most part, of very fine aggregates of quartz, sericite, and amphibole; the accessory minerals being iron ores, copper ores, blue tourmaline, and chlorite. The hornfelses were probably derived from

Fig. 4.—A Typical Island-Mount of Basal Complex Gneiss in Karamoja.

sedimentary rocks, which, judging by the large quantity of amphibole usually present, have been subjected to high temperatures and great pressures. Some schists occur, and asbestos is also present.

There are several forms of intrusives. Among these may be mentioned a not-very-common thulite-bearing rock. This is intruded into a talc-schist and is pink in the hand specimen. In thin section the rock consists of turbid plagioclase, much manganiferous zoisite (thulite), and a very small amount of secondary interstitial quartz. The age relationship of the pink rock to other intrusives is not definitely known. A very early intrusive, now sheared, is a muscovite-biotite-granite, while later come amphibolites and epidiorites. The next in order of appearance would seem to be an alaskite of (in places) pegmatitic coarseness. It is of special interest because it carries copper sulphides—mainly chalcopyrite. In

thin section it is seen to consist of tattered crystals of turbid plagioclase (probably oligoclase) showing fine twin lamellæ ; much crushed quartz with crenulated borders, and interstitial strongly mylonised quartz and felspar. Tourmaline is also developed, and in some specimens is fairly abundant.

Cutting the other intrusives is a dolerite. No. 1 adit is driven into this rock, which in thin section is very similar to dolerites intrusive into the sediments of the Bukoba sandstone series (*vide infra*). When fresh, the pyroxene is practically colourless, but easily develops brown pleochroic margins which steadily grow inwards, the crystal at the same time becoming pale green in the middle. The brown afterwards changes to green, and by the time the whole crystal has become a deep bluish-green it has been transformed into amphibole. The labradorite is fairly fresh and there is much interstitial micropegmatite, quite sufficient, in fact, to call this rock a grano-dolerite (Shand). The usual accessory ilmenite and leucoxene are present.

The copper minerals occur more in the country rocks—the hornfelses and schists—than in the alaskite, and appear generally to be impregnations more particularly along the cleavages and schistosity. So far as it is known, the structure of the cupriferous area appears to be essentially synclinal. It is also faulted.

Associated with the Complex, but apparently younger than the mass of it, are certain phyllites and sheared conglomerates occurring on Ruwenzori. They are probably paralleled in antiquity by others on the eastern side of Lake Victoria in Kavirondo (Kenya Colony).

Succeeding the Complex (and probably the conglomerates just mentioned) is an important system of phyllites with quartzites and conglomerates known as the *Karagwe Ankolean* (referred to for convenience as K.A.) (Fig. 6). The deposits are of great thickness and are presumed to rest unconformably upon the older rocks, but no undoubted junctions with them have been seen. The K.A. rocks have been thrown into a very complex series of pitching anticlines, synclines, and overfolds, and part of the movement which produced these results was associated with the intrusion of the Newer Granites, the apophyses of which have yielded mineralizing residuals that have produced the tin lodes of the south-western areas, and in the adjoining territories of Tanganyika, Belgian Urundi, and Ruanda. Ripple marks are of common occurrence in the quartzites, which persist for astounding distances, and locally the phyllites show beautiful banding, which on expert examination proves to be of seasonal origin (Fig. 6). The K.A. rocks appear to have accumulated on the slowly sinking bottom of a vast inland basin, comparable in size to that of Lake Victoria, but their lithology and distribution raise many problems. Repeated search and close study of the K.A., made

Fig. 5.—Gneisses of the Basal Complex Intruded by a Dolerite Sill.

over wide areas, have failed to reveal the slightest trace of fossil remains, and for this reason, and on account of their obvious antiquity, they are assumed to be Pre-Cambrian in age. Another area (a small one, about 600 sq. miles) lies to the east and south-east of the Kasinga channel ; another with a marked silicious facies exists around Mubendi, another near Jinja, and still another in Sese Isles.

Some remarkable iron ores are provided by hæmatite-schists, containing a little magnetite, interbedded with the Karagwe-Ankolean phyllites, particularly in the Kigezi district. They reproduce in replica all the fine structures of the phyllites, and are clearly due to replacement. Locally these ores are very abundant, and for such massive deposits they are astonishingly pure. The following are analyses of three samples made by the Imperial Institute.

	No. 1. %	*No.* 2. %	*No.* 3. %
Ferric Oxide (Fe_2O_3)	98·88	97·41	96·37
Ferrous Oxide (FeO)	0·16	1·26	2·98
Alumina (Al_2O_3)	0·08	0·78	0·13
Titanium Oxide (TiO_2)	Nil	Nil	Nil
Silica (SiO_2)	0·40	0·94	0·38
Sulphur (S)	Nil	0·004	0·004
Phosphorous (P)	Nil	0·006	0·009
Loss on ignition	0·28	0·17	0·33

The localities are as follows :—(1) Near Kabale, Western Province ; (2) Near Kigezi, Western Province ; (3) Jokana Estate, near Kampala, Buganda Province. Unfortunately, the difficulty of securing sufficiently large and accessible markets, and of good inexpensive fluxes and fuels stand, for the present, in the way of development of these remarkable deposits. Native smiths, however, make considerable use of them in some parts for the manufacture of hoes, spears, and knives (Figs. 9 and 10).

West and south-west of Masindi, in Bunyoro, and to the east of the Nile where it leaves Lake Kioga, is another great development of phyllites, phyllitic shales, mudstones and quartzites, with calcareous horizons, closely resembling the Karagwe Ankolean rocks in many of its features. It is on the whole, less metamorphosed, however, and less obviously intruded by granites. It was at one time spoken of as the Bunyoro facies of the K.A., but its contemporaneity with the phyllites of the south is much open to question, and it is doubtless better to speak of this development as the *Bunyoro Series*. From what is known of it, it appears to have suffered less folding than the Karagwe Ankolean, and has been considerably affected by faulting, mainly in two directions : One approximately north and south, and the other approximately east and west. It is, in fact, considerably block-faulted. Included in the lower parts of the sequence is an important tillite which closely resembles the Namees tillite of Namaqualand, with which it is possibly contemporaneous. There are, too, some

Fig. 6.—K.A. Phyllites, showing seasonal banding, near Kabale, Kigezi District.

curiously shattered junctions which closely resemble the frost-riven surfaces to be seen to-day at high altitudes on the equatorial heights (Mt. Elgon for example). Zones of silicification and ferruginization (with some manganese) follow the fault lines, but apart from the iron ores, which are utilized by the natives, they have so far provided no minerals of economic value, though copper, gold, tin (and even coal!), have been rumoured to occur in them. It is true that in this area, gold is widely distributed in some alluvial deposits belonging to antiquity and to the present age, but the source of the metal is not definitely known, and so far as investigations have gone, the deposits are too low grade to be workable.

Intrusive into the Karagwe Ankolean, particularly of the south-western areas, are certain granites which have now been divided by Combe into three: G1, G2, and G3. The G1 and G2 granites have a characteristic topographic expression. In Ankole and adjoining areas, denudation acting on the folded structures, already mentioned, results in general in synclinal hills, or hill groups, and anticlinal lowlands, so disposed, one to the other, as to provide an arena-like expression; crudely circular or oval areas of relatively low lying country being separated by mountainous (though peneplained) uplands which descend steeply to the arena floors. The uplands are characteristically occupied by K.A. rocks, and the lowlands (generally anticlinal or somewhat domoid cores) by the granites.

(*To be continued.*)

ALLUVIAL MINING WITH MECHANICAL EXCAVATORS

By W. E. SINCLAIR, A.I.M.M.

The author outlines a scheme for the working of certain types of alluvial deposits by means of a combination of dragline excavator and drag-scraper

In the MAGAZINE for October last there is a reference to the limited use which has been made of mechanical excavators in Malaya, a country renowned for its alluvial mines. In consideration of this fact it has occurred to the author that the following notes should serve to focus attention on this matter, for if it is surprising that greater use has not been made of excavators in Malaya, it is equally surprising that greater application has not been made of excavating machinery generally, not only in Malaya, but on alluvial fields everywhere. One most reasonable method for reducing costs per yard is by means of increasing yardage output. Often the only reason for not doing this, in alluvial mining, is the lack of ways and means. This handicap might often be overcome by the use of excavators.

Various forms of shovels and drag-scrapers are now being employed underground. These would-be excavators are revolutionizing mucking costs, despite rock material, cramped conditions, and artificial light. The underground engineers are unlucky in not being able to make their machines do some digging as well as shovelling. Alluvial deposits, on the other hand, often offer ideal conditions for excavating machinery, with the added advantage of having ground that can be excavated and shovelled by one and the same machine.

It is curious, therefore, that excavators are not more often seen on placer deposits and difficult to understand why they are so often regarded with something akin to awe by alluvial mining engineers. It is, perhaps, that the machines have not been given a fair trial where they have been used, or that there is much sceptical, if not foolish, opposition to their employment. In the opinion of the author many people do not realize that each and every type of excavator is a "specialist" in its own way. There is a special type of machine for every kind of job and the peculiarity of each job must be considered. This has probably not always been the case and therefore mistakes have occurred. In consequence, it behoves all engineers who have had experience to put such experience on record. Many good ideas have not crystallized, and many good efforts have died, for lack of engineering publicity. An application of a dragline excavator to mining alluvial tin was described by S. A. Westrop in the MAGAZINE for January, 1931.

Bearing these points in mind, further atten-

tion might be given to the following quotation from the letter of the MAGAZINE'S Ipoh correspondent in October last, reference to which has already been made. The letter states that: "A recent suggestion is to employ a pontoon equipped with grabs, which can be of any desired capacity, for excavation and recovery of values on a very uneven and pockety limestone bottom. This suggestion offers great elasticity in operation, especially as to depth, and if well run should permit a high rate of recovery from ground in which a bucket dredge would be able to dig only a small proportion of the ground. The size of grab can be varied to suit the ground so that the rate of treatment can be adjusted to permit quick handling of poor ground and more careful treatment where values are higher. If desired such a method could locally be made preliminary to complete cleaning up with pumps and monitors . . ." It is shown in the following notes that it would be highly desirable and most essential to "clean up" by some efficient means, after grab operations, for the reasons given. Before proceeding with this point, however, it may be asked why a pontoon-grab plant is suggested, when the ground can be partly treated by bucket dredge and finally cleaned up by monitors and pumps? Conditions which are not referred to in the brief reference may account for the proposed modus operandi, but it would seem at first glance that this is a job for either (1) dredge, or (2) pumps and monitors. Where, however, grabs are indicated the following points are of the utmost importance.

As is generally known, the grab, in its simplest form, consists of a hinged bucket made up of two or more clam-shells suspended on a main hoist rope, which is operated by an ordinary power winch. The bucket or grab consists of clam-shells or toothed scoops, hinged together at the top, making jaws which open and close to form a bucket, or receptacle. The size and type of clam varies as does the method of opening, and/or, closing, which is controlled by the operator, or driver. The working of the grab excavator consists simply in raising or lowering the bucket, and swinging the machine or jib round radially to cover an area within its reach, when this is necessary. The control and operation is therefore simpler than the working of a shovel or dragline, each of which requires the services of an experienced operator, and in some cases, the assistance of a craneman. The grab would probably offer greater elasticity in operation than the shovel, but not any more than a dragline, except perhaps when operating at great depths under water.

Digging alluvial ground which carries heavy concentrates such as gold or tin, under water, raises a question, however, which cannot be lightly disregarded. It will have to be estimated just what amount of loss occurs in the values due to—(1) spillage, and (2) the concentrating action which takes place while the loaded clam or bucket passes through the water. Reference is made to an earlier paper by the author on "Steam Shovel Mining in Nigeria,"[1] a digest of which appeared in the MAGAZINE for June, 1930. In this paper an account is given of the working of a dragline at Liruein-Kano, and it is recorded that "a certain portion of the ground handled by the dragline was under water. It is possible that a large proportion of the tin contents of the ground happened to be on the bottom or on bedrock, and it would seem likely that a certain amount of spillage would occur as the drag-bucket moved through the water, when digging the ground to bedrock; but in spite of this possible source of loss in the recovery of the tin bearing wash, the actual recovery of concentrates was consistent with the proved value of the ground . . ."

Nevertheless, spillage does take place and to avoid loss in values as a result of this, repetition is usually necessary, that is, the bedrock must be gone over several times in order to pick up the spillage. This means—low bucket capacity, small yardage, and heavy costs.

The losses in values due to spillage are increased by the losses due to the concentrating action and leakage, where buckets or grabs are not water tight. This fact has been observed in practice, where alluvial wash was being dug under water by a power shovel. The depth of water in this particular case was only 4 ft. and the wash being excavated was a heavy, compact, alluvial sand and clay. The bedrock consisted of a fairly soft decomposed granite, a "skim" of which was removed with the wash, in each bucketful excavated, as the work advanced. Later, when the shovel had moved on, and the bedrock over which it had passed was drained, patches of tin concentrate were found at scattered but regular intervals.

[1] *Bulletin* of the Institution of Mining and Metallurgy, May, 1930.

This concentrate, lying on bedrock, was undoubtedly the result of the concentrating action of the wash in the shovel bucket, as this moved up through the water in the natural excavating motion.

It would also appear essential that a grab must "take up" some of the bedrock, to ensure recovery of the values thereon. Favourable bedrock should therefore be soft, so that the teeth of the clam-shells may scrape into the bedrock before the bucket closes. It is doubtful whether this desirable action would occur, unless an improved method of effectively closing the clam-shells before the bucket leaves the bottom can be devised. As it is, the closing action of the clams is brought about simply by the pull exerted on the hoist rope, which causes the jaws to close. Sometimes, however, this means that the grab is clear of the ground, or bedrock, before it is actually tightly closed, in which case the values might often be left behind. This deficiency was noticeable on an occasion when fine copper ore was being handled by a grab from a stock-pile. When working on the virgin ground at the foot of the dump, the teeth of the grab had to dig right into the ground, taking some of the ground with it, in order to make a clean job of the ore. Failing this, the ore had to be swept up by hand to effect a clean recovery.

While the foregoing observations show the type of result to be expected when excavating alluvial gravels under water, it is not intended to belittle the excavator in its capacity and usefulness on an alluvial proposition. The right machine on the right job will handle ground like no other machine. In addition to being of use in breaking ground, these mobile machines are invaluable on an alluvial mine in many other ways, such as: Moving plant or machinery; pipe-laying; pile driving; loading or off-loading materials; cutting canals or ditches; building dams, etc.

One difficulty in handling heavy machines of this type on alluvial deposits, is the occasional presence of soft clayey ground in the vicinity of river beds or swamps. Makers will declare that their machines, fitted with caterpillars, will go wherever one is able to walk, a statement which, though true in a sense, would in practice often end in catastrophe, if a heavy machine trusted its weight on swampy ground, which might comfortably bear the weight of many men. These machines will travel, however, where other portable plant of the same weight would not, or could not, be moved.

Many alluvial deposits are situated in or near rivers, swamps, or ancient river beds, where the ground is moderately soft and sometimes even treacherous. In deposits where the ground is firm and hard, and even in river-bed deposits, it is sometimes found that the richer patches have been partially worked or picked-over in a haphazard way, or worked by primitive methods, pits and holes being left on the ground. Conditions on such a deposit, as in the case of all river-bed deposits, make the use of heavy excavators a risky venture, owing to the danger of their sinking in and becoming bogged, or of capsizing and breaking up. Otherwise, it is obvious that this ground can easily be handled by excavators. In order, therefore, to overcome the difficulties present on such locations, the author suggests the employment of an ordinary dragline excavator in conjunction with a drag-scraper in a manner outlined in the following paragraphs.

The proposed arrangement gives the ideal combination, in one flexible unit, of a machine which breaks the ground, hoists and delivers to dump or sluice boxes, all in more or less

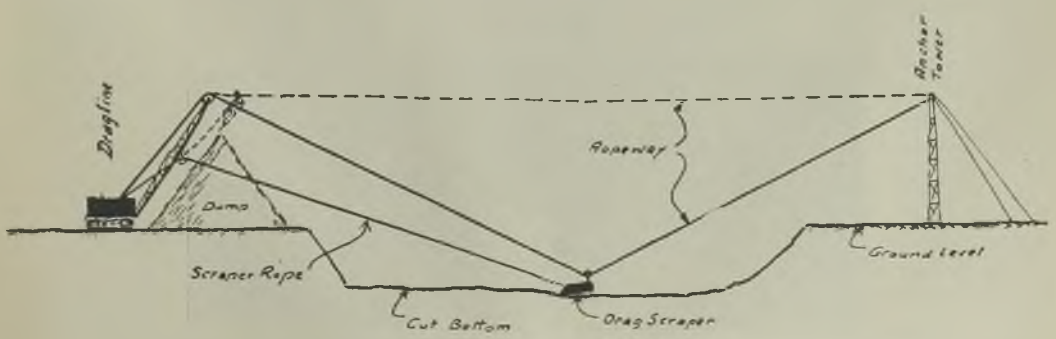


FIG. 1.—SECTION SHOWING DIGGING AND DUMPING POSITION OF DRAG-SCRAPER.

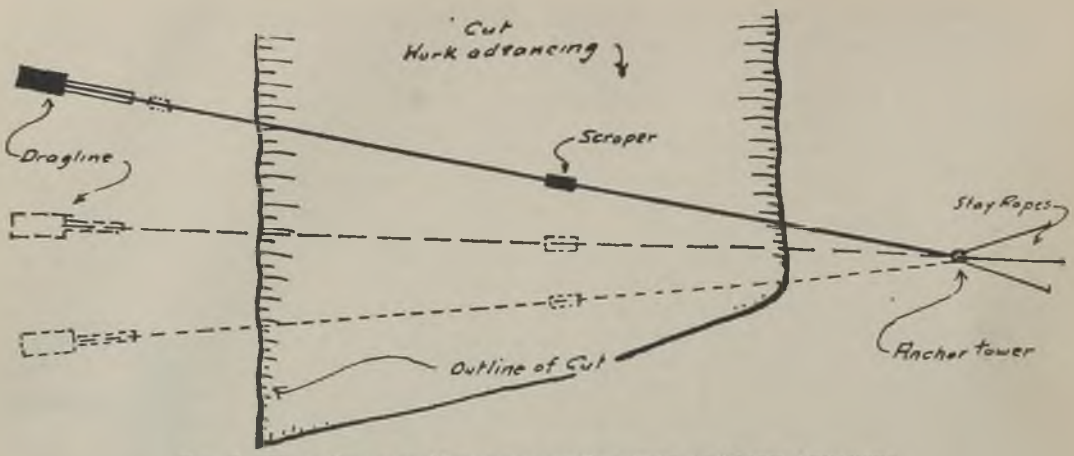


Fig. 2.—Plan Showing Movement of Dragline as Work Advances.

one action, and without the danger of the heavy machine approaching the excavation. Such a method would be a decided advantage where a shortage of water necessitated dry stripping of a barren overburden, or it could be utilized to stack ground in convenient dumps ready for sluicing in the "rains" or when a supply of water is available. Under normal conditions it could deliver wash to sluice boxes erected on either side of the cut. The power unit would be provided by a dragline, and the digging and conveying medium is a drag-scraper bucket controlled by the dragline.

The sketch section shown in Fig 1 illustrates a possible lay-out with the dragline on one side of a cut (which covers the whole or part of the alluvial deposit), and the anchor tower on the other side. The anchor tower holds one end of the rope-way, which carries the scraper bucket. The bucket is supported by, and runs along the rope-way by means of an enclosed sheave. The main hoist engine and drum on the dragline would be utilized for providing digging power for the drag rope on the scraper bucket. Another engine and drum would control the required slackness or tautness in the supporting rope-way. Operation of such a lay-out would be controlled by one man from the dragline. The process of digging would comprise the following operations :

(1) Slack off drag bucket.

(2) Slowly slacken rope-way, in order to allow the drag bucket to return to "cut" by gravity.

(3) Tighten up drag bucket rope to digging action, as is done in ordinary draglining.

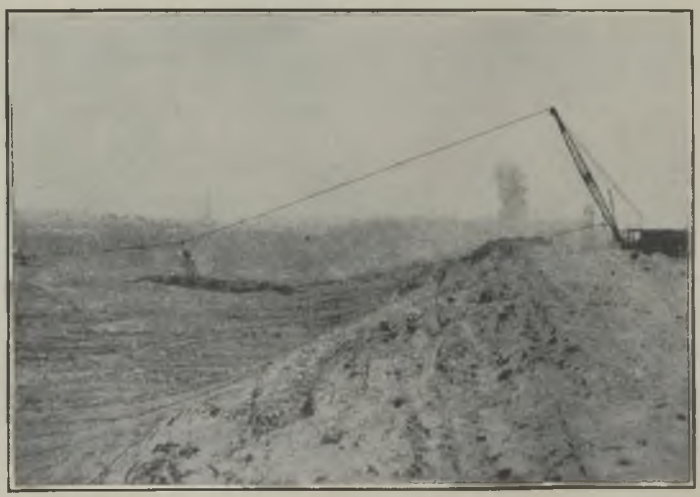


Fig. 3.—Construction of a California Levée by a Combination of Dragline and Drag-Scraper.

(4) When bucket is full, tighten up ropeway and at same time draw up scraper bucket.

This arrangement would allow for dumping of material on the dragline side of the " cut " only. Dumping could proceed until the dump reached a height which would hinder further stacking. The dragline could then move a short distance along the length of the " cut " in order to clear the dump, or alternatively, the dump could be moved back by ordinary draglining methods, if it were essential to keep the dragline in one position. It will be seen from the plan lay-out in Fig. 2 that it would be found that the natural movement of the machine would be up the length of the " cut," as the work advanced.

Where it is desired that dumping from the scraper bucket should be done on the opposite side of the " cut," i.e., at the anchor tower end, the same general idea could be utilized with the addition of a tail-rope on the scraper bucket. This would necessitate a double-drum winch on the dragline, and the operation would then consist of the common drag-scraper methods. Details of the working of such an arrangement were described in the issue of the MAGAZINE for August last, in an extract of an article by M. Moore, which appeared in the *Chemical Engineering and Mining Review* of Melbourne.

In the suggestion put forward in the present article, where a dragline is used instead of a stationary mast, the fact that the operating unit is mobile is a great advantage, which will be immediately recognized. Such an arrangement allows large areas to be covered with no loss of time in moving plant. In addition, all the advantages of the dragline will be had for such preliminary work as may be necessary on the deposit and in the general lay-out before it is tied up as an operating drag unit.

Since the foregoing notes on the use of excavators in alluvial mining were written, the writer has seen that a contractor, Mr. T. G. Smith, of California, has anticipated his scheme and put into practice the mode of operation outlined. From the reports of operations which are available it is evident that this method of breaking and handling ground has been proved successful in practice, under conditions somewhat resembling alluvial mining. The following notes of the methods employed by Mr. Smith are taken from his article,[1] as well as the photographs shown in Figs. 3 and 4.

FIG. 4.—SCRAPER LIFTED CLEAR OF WORK AND RETURNING TO PIT BY GRAVITY.

" On a flood control levee job on the Los Angeles River . . . Mr. Smith is using his caterpillar mounted dragline machine as the power unit and mobile head tower for a power drag-scraper, thus giving the dragline the increased operating range sufficient to handle the borrow pit in a single operation, and giving the drag-scraper the mobility of the dragline machine. With a track line from the top of the boom to the tail anchorage, the scraper works on the high speed gravity return principle . . . The combination of dragline and drag-scraper is not strictly new, but its application on a job of this character is a significant development in excavating practice."

[1] *The Earth Mover*, October, 1931.

THE BEATRICE MINE, SELIBIN, F.M.S.

By E. S. WILLBOURN, M.A., F.G.S.

(*Concluded from the December issue, page* 341.)

METHOD OF MINING.—The dip continued at the same general angle of 1 in 4 to L, underneath a spot about 550 ft. measured horizontally in direction 196° from N, giving a length to the pipe of about 700 ft., 100 ft. of which had been eroded away between M and D. It had become too costly to blast an open trench in the limestone, and the pipe had been followed by a huge tunnel sloping downwards from the south end of the trench. The method of working was by underhand stoping. The tunnel was driven into the limestone over the top of the ore, and its floor blasted into, so that the pipe was reached, operations being continued down through it until the ore had been removed and barren stone had appeared again.

The pipe had, until this time, dipped so constantly in a southerly direction at 1 in 4, that a haulage-incline had been constructed in the trench, up which the stone was conveyed to the mill in trucks like those used in open-cast, alluvial mines (Fig. 4). Towkay Leong Tean had bought the land (lot 21158) to the south of the lot in which the pipe occurred (lot 26201), as well as most of the land on both sides, and had sunk a shaft on the line of continuation of the pipe to try to meet its presumed southerly extension. When the paper was completed for the MAGAZINE at the end of September, 1926, mining operations had reached L, 123 ft. below the limestone surface, i.e. about 150 ft. below ground-level.

FIG. 4.—HAULAGE INCLINE PASSING INTO TUNNEL AT BEATRICE MINE.

Faults had been very common on the ore-body, and from D to Z most of them had strike about east and west. From Z southwards it was noticed that faults with strike approximating to north and south had become abundant and that they had given rise to frequent cases where the margin of the pipe, as exposed by mining-operations, was a fault, with barren crystalline limestone on one side and ore on the other (Fig. 5). It must be remembered, however, that when the pipe was formed the margin was everywhere of a true intrusive nature. The faults had occurred subsequently to the formation of the pipe.

Towards the end of 1926 the usual southerly continuation of the tunnel failed to find the pipe, and it was discovered that at a depth of about 160 ft. below the limestone-surface the pipe had changed its direction to eastwards, but at a much steeper angle than before, sometimes, indeed, being almost vertical. Naturally, the mine now became deepened at a quicker rate.

In July, 1927, at 215 ft., the exposed top of the pipe had dimensions 57 ft. in direction 60° by 240°, and 32 ft. at right angles. The ore, now, as always, was patchy; certain large areas on the floor of the excavation were very rich, with as much as 90% of tin ore, while in other parts no tin ore was visible to the naked eye. At the end of November, 1927, at 253 ft., the greatest length was 75 ft. in direction 35° by 215°, and it was 19 ft. at right angles to this. The north-west margin of the pipe at this stage was a fault, whereas all other margins showed the ordinary intrusive contact. At the beginning of March, 1928, at 270 ft., the dimensions were similar, and numerous faults were evident. Until this period, all drilling had been done by about thirty coolies

using hammer and hand-drill, but now an installation of compressed air was used to operate three rock-drills, though it was usual to have only two working at a time. Twenty-five coolies were still kept at work with hand-drills.

In August, 1928, the depth was 300 ft., and the cross-section of the pipe was dumb-bell-shaped, 100 ft. along a N.E. by S.W. line, by 15 ft. to 35 ft. at right angles. It had a steep dip towards S.E., and faults were just as strongly developed as before. At the end of October, 1928, it was 90 ft. long in direction N.E. by S.W., and 12 to 15 ft. wide, and the ore was still rich. In February, 1929, at 360 ft., the ore-body was smaller, being 45 ft. along a line N.N.E. by S.S.W. and 12 ft. wide at right angles to it. The dip of the pipe was steep towards east, and the foot-wall was a strong fault, while on the S.E. margin the minerals were arranged in parallel bands due to shearing after the pipe was formed. Amongst many other faults, a strong one striking east and west was noticed in the southern part of the pipe, but with a displacement of only a few inches.

Disappearance of the Pipe.—In April, 1929, at 390 ft., the pipe suddenly ended against a mass of granite, and a shaft sunk into the granite failed to find ore. The surface of contact of granite with limestone dipped 45° towards east, and the limestone here displayed pronounced black and white banding parallel with the contact, while a chlorite-band which marked the actual contact was very much slickened and disturbed. This was unmistakable evidence that strong shearing had occurred along the contact after the chlorite-band had been formed, i.e. after the granite had solidified.

It is now clear that the mine had reached the sheared zone of the granite-limestone contact so early as 1926, when mining operations had reached that part of the pipe where its dip had changed from 1 in 4 south to be steep towards east, for, from that period, a sheared margin on the western edge of the ore-body was often noticed. Subsequent work at level 280 ft. lay bare the granite-mass only a few feet to the west of the spot where the pipe was then being mined.

The first account of the Beatrice mine was written before the steeply-dipping part of the pipe had been revealed, and it was then thought likely that the ore originated in the granite to the north. No granite was known in the south, and the gentle dip of 1 in 4 towards south could be accounted for by the numerous faults. The steeply-dipping, almost vertical, extension of the pipe that was later met, however, and the subsequent discovery of granite in depth, made it clear that the origin of the pipe was in this granite, at the south end of the pipe. Undoubtedly, the ore came from the granite and it would be an unexpected thing in view of the very rich ore that occurred in the limestone next to the granite, if the

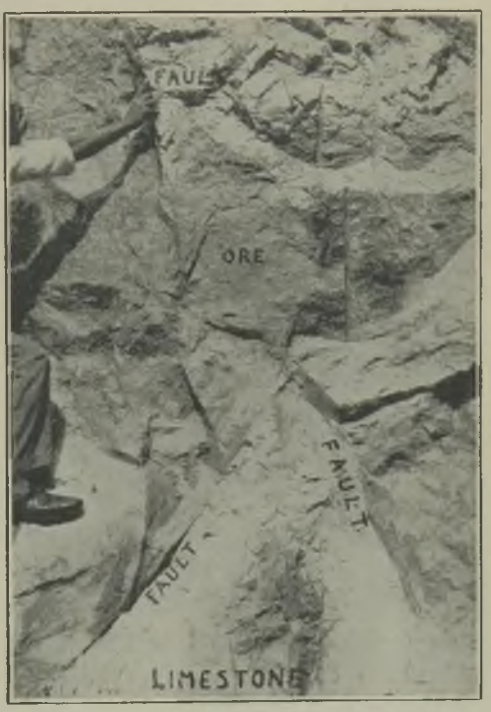


FIG. 5.—FAULTS CUTTING THE PIPE.

root of the pipe actually in the granite were not tin-bearing. A strong fault along the contact broke the pipe in the limestone away from the root of the pipe in granite and all prospecting work now should be directed towards finding this presumed extension in depth.

The presence of the granite below the pipe was not known in March, 1929, when the writer went on leave to England and the account of the mine that was published in the Report of the Geological Survey Department, Federated Malay States, for 1929, was written before the mine had been de-watered after the writer's return to Malaya to allow of an examination of the granite-mass. It was then considered possible that the granitic rock might be a dyke which had

cut across the pipe subsequently to its formation, but the evidence made available on pumping the mine dry, left little doubt that this was not the case ; the granite was the source of the tin-ore.

Certain preliminary work towards beginning a systematic scheme of prospecting for the root of the pipe in the granite was then done, including the sinking of two winzes to 100 ft. in the granite below the place where the pipe had disappeared, but the management closed down operations before

Fig. 6.—Magnesium Borate at Margin of Pipe.

beginning the easterly cross-cuts which had been projected.

Minerals in the Pipe.—Twenty or thirty other pipes in limestone have been examined in Malaya, in which, as a general rule, the ore has consisted of arsenopyrite, pyrite, chalcopyrite, and cassiterite, imbedded in a crystalline matrix of white calcite and dolomite which have come from the recrystallization of the limestone. Some contain other sulphides, including pyrrhotite, galena, blende, bornite, stibnite, jamesonite, and stannite, the two last-named having been detected first by Dr. F. T. Ingham, but the commonest sulphides are arsenopyrite, pyrite, and chalcopyrite. In the case of a few pipes there has been chemical reaction between the silicon and oxygen of the hot vapours or solutions which carried the tin, and the calcium and magnesium of the limestone country-rock, to make the silicate of calcium and magnesium which is known as tremolite, $CaMg_3(SiO_3)_4$, but, except at the Beatrice mine, the chief gangue-minerals have been calcite and dolomite.

At the Beatrice mine the last-described reaction was complete, so that the whole of the limestone which formerly occupied the space now filled by the pipe was changed to tremolite, with a minor amount of other minerals, the carbon dioxide of the limestone evidently having escaped along fissures. The complete absorption of the limestone to form tremolite is in itself sufficient to mark the Beatrice mine pipe as unique amongst tin-deposits. The ore-minerals were arsenopyrite, cassiterite, and chalcopyrite, with a little stannite, bornite, pyrrhotite, etc. ; the gangue-minerals, other than the tremolite, were fluorite, and a mineral, elsewhere unknown, which is mainly composed of magnesium, boron, and combined water. Changes caused by faulting after the deposition of the ore brought in a small amount of calcite to a few parts of the pipe, and partially altered the tremolite to mica and talc.

It should be noted that the limestone of the Kinta Valley is a very pure rock consisting of carbonate of calcium and magnesium, with very little impurity, so that the chemistry of the various reactions that occurred between the country-rock and the tin-bearing solutions is simpler than in the commoner cases where those solutions penetrated granite or schist. Most primary tin-deposits are accompanied by the formation of tourmaline, a mineral of complex composition, which contains boron, and the presence of tourmaline in such tin-deposits, or in the country-rock near them, has supported the generally accepted theory that boron was a " carrier ". Another carrier was fluorine and the abundance of sulphide-minerals in these pipes in limestone indicates sulphur as another. No tourmaline has been found in any of the tin-bearing pipes in the limestone of Malaya except for a few yellow crystals in a small deposit at Siputeh and, with few exceptions, no other boron-mineral has been detected in them either. The exceptions are the occurrence of axinite (a boron-containing mineral) with cassiterite, as, for instance, at a now abandoned mine at Kanthan, Chemor, and another noteworthy example is the magnesium borate mineral at the Beatrice mine.

The magnesium borate mineral was detected at the margin of the pipe in the

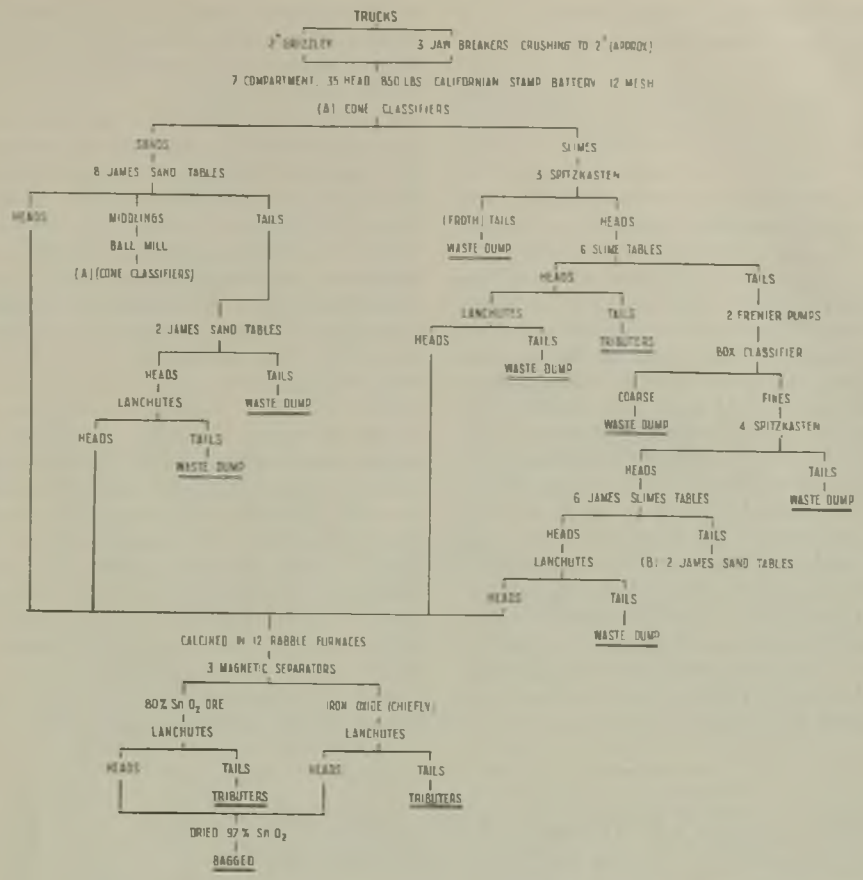


Fig. 7.—Flow-Sheet of Beatrice Mine Mill.

open trench near D, and can still be seen in the remnants of the pipe left there. It is a light-brown, resiny looking, translucent, compact, amorphous mineral, with hardness about 5, and specific gravity 2·94. Under the microscope, it is seen to be an aggregate of tiny flakes which resemble mica, and with it are tiny flakes of real mica, which, unfortunately, have so far proved an unsuperable obstacle towards getting material pure enough for an analysis. Many specimens showing the mineral in a white opaque condition, due to some form of alteration, which may be hydration, have been picked from the dump. When found *in situ*, the mineral occurred near the margin of the pipe, enclosing the various ore-minerals just like the ordinary gangue (Fig. 6).

A number of microscope-slides reveal that the mineral has sometimes crystallized in a different fashion from the micaceous habit just described, for it occurs as rod-like prisms, with a cross-fracture rather similar to that of tourmaline. The rods extinguish straight and show marked change in relief when viewed by polarized light as the nicol is rotated (twinkling), one of the refractive indices being lower than that of canada balsam. The polarization-colours are similar to those of muscovite, but the mineral differs from mica in that the rods do not display a longitudinal cleavage. The reason for the two different habits seems to be that when the magnesium borate mineral was formed under conditions which did not permit of free crystal-development, it solidified as the aggregate with micaceous habit, whereas, with more room for growth, it crystallized as the rods.

Sequence of formation of the minerals.—Microscope-work indicates that the following sequence took place in the pipe :—

1, The tremolite was first formed ;

2, next arsenopyrite was deposited ;

3, cassiterite next ;

4, chalcopyrite being the last ore-mineral, and

5, the mica, talc, and the magnesium borate were the result of alteration of the tremolite.

As would be expected, the composition of the pipe was by no means constant, for certain parts of the pipe consisted of tremolite with little or no ore-mineral, others were rich in arsenopyrite, while still others had so much cassiterite as to leave little room for anything else. It is still, to-day, possible to examine parts of the pipe at the mine, for the management left much that was not visibly rich in tin-ore and there is plenty of stone, composed mainly of tremolite and arsenopyrite, to be seen in easily-accessible parts of the mine. No vertical zoning of different ore-minerals occurred ; for instance, there was no less chalcopyrite near the granite, at vertical depth 400 ft., than there was in that part of the pipe at the limestone-surface. This, however, is not remarkable, for the distance of the uppermost part of the pipe, measured directly to the granite, was not so much as 300 ft.

Treatment of the Ore.—Mr. R. F. Shutes, of the Mines Department, Federated Malay States, kindly assisted in compiling the attached flowsheet (Fig. 7), which summarizes the method of extracting saleable tin ore and white arsenic from the stone. For several years, sluice-boxes (lanchutes) alone had been used for washing tin-ore from the stamp-battery pulp and the *amang* (heavy residue) which was thrown away still contained a valuable quantity of cassiterite. After the James tables were installed the old *amang* was put through the whole process shown in the flowsheet, beginning at A, cone-classifiers.

The metallic minerals were roasted on twelve enclosed hearths, to drive off the arsenic and sulphur. Flues from the hearths led into long brick-built chambers, in which a series of walls had been built to act as partial barriers to the passage of the vapours and, as the chambers were kept cool by continuous sprays of water on the outside, the "white arsenic" (arsenious oxide) sublimed and was trapped in them. The white arsenic was sold for 50 cents a pikul (about £1 a ton), to be shipped to Australia in steel drums for use as sheep-dip.

KATANGA TIN PROPERTIES

By R. W. SCOTT, A.I.M.M.

The author gives a description of work on certain alluvial tin deposits of which relatively little is known.

Much has been written in connexion with the copper deposits of the Belgian Congo, but strange to say very little has been heard of the possibility of that country becoming in the near future a very important tin producer. The known tin deposits of the Congo extend over a very large area and many more will undoubtedly be found when the country has been thoroughly prospected.

The writer was engaged in 1929, to examine and report on the tin properties of the Geomines, Cie. Géologique et Minière des Ingénieurs et Industriels Belges, Société Anonyme, Mr. Frank Powell at that time being their consulting engineer in London. The journey from London to the property occupied thirty days, the route taken going via Brussels, Marseilles, Dar-es-Salaam, Kigoma, Albertville, Kabalo, and Muyumba. Muyumba is the station on the river Lualaba where tin is shipped, and it is connected by light railway with Manono, the headquarters, a distance of 53 kilometres.

Properties.—The areas worked by the company may be arranged in three groups :

I. The Manono or main section.
II. The Southern groups.
III. The Western mines.

By far the most important are the Manono and Kitotolo areas of the first group and it is on this section that the bulk of drilling and prospecting has been done. The drills employed on this work were Foraky power-drills, of which five were operating, one European foreman with the necessary native gang working each drill. A superintendent engineer was responsible for all the drilling.

The Manono Deposit.—The main deposit at Manono is located in a pegmatite formation, although the bedrock is mica schist. A capping of laterite covers much of the pegmatite and this again is covered by eluvial gravel, ranging in thickness from two to fifteen feet. After the discovery of the deep deposit and when scout drilling had proved

its continuation, a scheme of close drilling was carried out, with the result that at the end of 1929 the reserves stood at 60,000 tons of 70% cassiterite, value 2 lb. per cubic yard. The latest figures available show that this has now been increased by 40,000 tons, giving a total reserve figure of 100,000 tons. The depth of this deposit varies from fifteen to sixty metres.

The tin ore present in this deposit is of a very good quality and it is easily separated. To check the drilling values and also to test the treatment of the material a shaft was sunk on the deposit. The ground taken from the shaft was put through a sluice box and the recovery checked slightly above the drilling estimate. The ground on the pegmatite zone is so friable that the shaft had to be timbered; and the tests showed that the ground could easily be treated by ordinary sluicing methods. A Ruston shovel was erected on the site to test the workability of the hard laterite and eluvial gravel and no difficulty was experienced in handling this material. This deposit has been worked for a great many years, but so far only the gravel overlying the laterite has been treated.

The method of working in the past has been by the use of small sluice boxes, 14 ft. by 1 ft. 6 in. These were kept up to the face in the paddock and the tailings were thrown back. Five to six labourers were employed on each box, the number of boxes being controlled by the size of the paddock to be worked. The water for sluicing was pumped from the river to a reservoir above the workings and then gravitated to the boxes, being then returned to the river to settle. This method of working required much labour. The concentrate from the various paddocks was collected each day and conveyed to the dressing plant, where it was bagged for rail transport to Muyumba.

Fig. 1.—Sketch-Map Showing Route to the Katanga.

Labour.—The labour for this work is recruited, in some cases being brought many miles. Recruiting officers are employed by the company, and these collect and despatch the labour to the mines as required. Labourers are well cared for and they are considered in every way, being clothed, well fed, and comfortably housed, and also being well paid. The usual period of service is a year, but this may be renewed.

Special interest is taken in the native children by those in charge, and each week they are examined and weighed by the hospital staff, clothing and special food being given to the sick. Prizes are also distributed to the mothers for the best-cared-for children. Very much has been told of the bad treat-

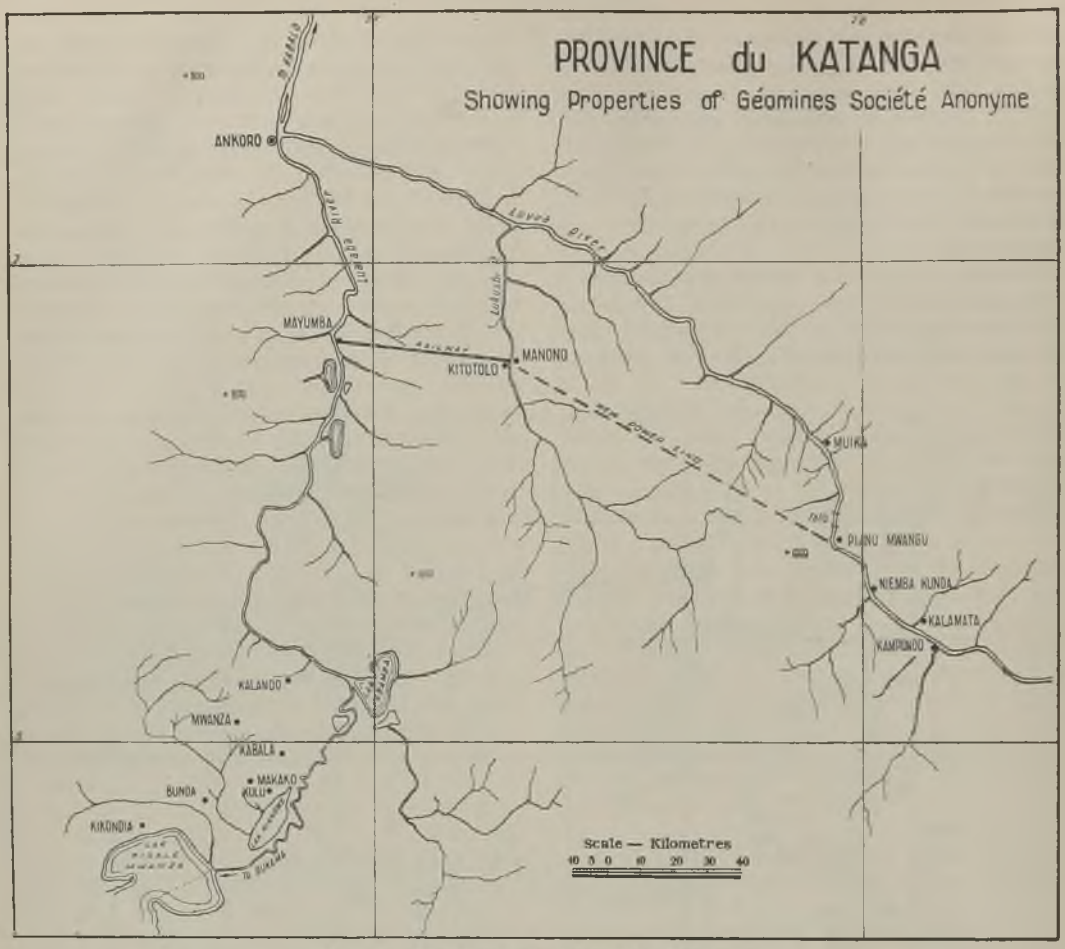


FIG. 2.—LOCATION OF PRINCIPAL DEPOSITS.

FIG. 3.—WORKINGS AT KABALA N'KULU.

ment of the Belgian Congo native, but this certainly does not apply to the employees of these mines.

PLANT.—The original plant operating on the mines, for the treatment of the surface deposits, consisted of small steam and electrical pumping and lighting plants, a well-equipped fitting and repair shop, a locomotive, and a saw-mill. The company have also a steam launch operating between the various mines on the rivers. The new plant contemplated for the treatment of the Manono and Kitotolo deposits will provide for the handling of 300,000 cubic yards of ground per month. It is proposed to work the deep part of this ground with a combination of shovel, gravel pump, and belt conveyor. Much of the shallow part of the deposit is suitable for handling by a dredge.

Unlimited water is available for all purposes and provision is being made for the storage of a very large supply to carry over the dry part of the year. A hydro-electric power station is being erected on the Luvua River, from which power will be transmitted to Manono. This cheap power will play an important part as regards tin mining in Katanga.

TRANSPORT. — Communication between Katanga and the sea has been much improved within the last few years. In addition, travel on the very comfortable river boats, which weekly connect up with the railway and aeroplane services and which are often crowded with tourists travelling to and from the Cape, undoubtedly confirms the fact that the mineral wealth of the Congo is being thoroughly and quickly developed.

BOOK REVIEWS

Handbuch der Geophysik. Edited by Prof. Dr. B. GUTENBERG. Vol. II. Part I, paper covers, 564 pages, illustrated. Price RM 102 (subscription RM 68). Vol. VI. Part I, paper covers, 312 pages, illustrated. Price RM 63 (subscription RM 42). Berlin: Gebrüder Borntraeger.

These parts are in continuation of others which have already appeared and which have been reviewed previously. The high standard set by the earlier parts is fully maintained by those now under notice, and there is little that can be criticized in them. The first, dealing with the "Formation of the Earth," opens with a short section by Gutenberg on the "Cooling and Temperature of the Earth," in which the various theoretical considerations effecting this process are expounded. Then follows a lengthy and detailed section on the "Chemistry of the Earth," by Berg, who, after considering the chemical composition of various portions of the earth's crust and the terrestrial distribution of the elements, proceeds to treat the geochemistry of each of the elements individually and effectively.

Practically one half of the book is devoted to a section by Born on "The Age of the Earth and the Geological Ages." In this section, an introductory chapter, dealing with the division and measurement of geological time, is followed by one on general paleogeography, while in a subsequent chapter on the history of the earth, each of the geological periods is treated separately and with completeness. Gutenberg also contributes the last section of the book, which deals with the physical structure of the earth. He discusses the conditions within the earth's crust from a theoretical standpoint and devotes separate chapters to each of the following properties of the earth's interior:—density, rigidity, compressibility, elasticity, and viscosity. The treatment of the last section, unlike the rest of the book is mainly mathematical, and although of considerable value to the geophysicist, is not likely to appeal to the average geologist.

The second of the books under review deals with the "Geophysical Methods of Prospecting," and is divided into four main sections. In the first part, by Reich, the author, after describing and classifying the geophysical methods, gives an interesting and valuable account of the various physical properties of rocks—such as the density, elasticity, electrical-conductivity, and magnetic susceptibility—which are made use of in geophysical prospecting, while useful tables of these values are also included. A second section by Hunkel is devoted to the electrical methods of prospecting. Here he discusses first the development and application of the spontaneous polarization method, and then proceeds to consider all the various methods employing artificial earth currents and, finally, the high-frequency methods. Speaking generally, the treatment of this section is thoroughly sound and modern—as may be instanced by the references to the Schlumberger method of electrical coring,

but one would have welcomed the inclusion of at least one or two illustrations of apparatus, while a modern description of electrical prospecting methods which contains no mention of Broughton-Edge, can hardly claim to be complete.

The remaining two sections of the book deal respectively with the theory of the gravitational method of prospecting, and the instruments employed in these methods. In the former Ansel describes at considerable length the methods employed for determining the relative intensity of gravity both by the pendulum and the gravity variometer, the various errors that are likely to occur in practice, and the different corrections that have to be applied in order to eliminate them. A description of gravitational prospecting instruments, by Meisser, forms the last section, but is incomplete, and includes only a consideration of the pendulum. Presumably the gravity variometer in all its forms will be dealt with in a subsequent part of the publication. The treatment here given is extremely thorough and up to date, giving useful descriptions and illustrations of the recent modifications of von Sterneck's apparatus, which have been introduced by Meinesz, and still later by Lenox-Conyngham.

The main criticism which can be levelled at the second of these books is that it is somewhat unbalanced. A comparison of the space devoted to the electrical methods with that allotted to the gravitational method hardly appears to do justice to the former, and this unbalanced relation will be intensified by the publication of Part II of this volume, in which the gravitational method will receive further consideration.

H. SHAW.

Lehrbuch der Bergwerksmaschinen (Kraft- und Arbeitsmaschinen). By H. and C. HOFFMANN. Second edition. Cloth, quarto, 402 pages, illustrated. Price RM. 24. Berlin: Julius Springer.

This second edition published in November, 1930, follows quickly upon the first edition published in 1926. It includes advances which have been made in the interval, while some machines, previously mentioned but now obsolescent, have been dropped out. The book starts with a summarized statement of thermo-dynamics, including the entropy aspect of compressed air. Then, occupying the first half of its total pages, it deals with fuels, combustion, steaming plants, flow in pipelines, steam engines, steam accumulators, and internal-combustion engines, practically entirely from the view-point of power production, though some mining machines using power are mentioned, internal-combustion locomotives, for instance. Winding engines and installations next occupy fifty pages, winding systems and winding ropes being first treated, and then steam winders with their control and efficiency. Pumps are then described in just over twenty-five pages under two sections, namely, plunger and centrifugal pumps, their design, efficiency, characteristics, and respective suitabilities.

At this point a description of air compressors, piston, turbine, and rotary, intervenes for another twenty-five pages, followed by a short section of high-pressure compressors and compressed-air locomotives, and then by the distribution and use of compressed air at ordinary mining pressures. In this use the various types of engine, reciprocating, turbine, and rotary, are described, and then the mining machines using compressed air, namely, haulage engines, coal-cutters, pneumatic picks, rock drills, conveyor engines. Then about ten pages are given to ventilators of different types and the mechanical characteristics of their working, together with the mechanical aspect of the air circuit in the mine openings. The use of electric energy in mines is then exemplified by brief descriptions of electric winders, haulages, and locomotives, and mention is made of the electric driving of pumps, coal cutters, and conveyors.

The final section is descriptive of the measurements of rotative speeds, turning moments, gas and fluid pressures, gas and water quantities, etc., such as find application in checking and surveying the economy of the machines mentioned.

The book is described as being a textbook for the mining school at Bochum in the Ruhr coalfield, where underground superintendents are trained; as such, it must be regarded as in the highest class. It is indeed a book which can be recommended to all mining engineers. Its illustrations, type, and format have the perfection associated with the house of Springer, the publishers. It is interesting to note that about three-fifths of the book is devoted to power generation and transmission, this latter including air compression, and about two-fifths to mining machines proper. This is a fair relation, and one in harmony with the fact that in the mining industry more power is used for a given

value of output than in any other industry. No mention is made of water power.

S. J. TRUSCOTT.

Ausgewählte Methoden für Schiedsanalysen und kontradiktorisches Arbeiten bei der Untersuchung von Erzen, Metallen, und sonstigen Hüttenprodukten. Second edition. Paper boards, xx + 457 pages, illustrated. Price 20 RM. Berlin: Gesellschaft Deutscher Metallhütten- und Bergleute e. V.

This useful publication, which was originally issued in two parts, has now, in the second edition, been produced in one volume. Some new chapters have been added, dealing with beryllium, mercury, selenium, and tellurium, and the chapters on sampling have been eliminated and reissued in a separate volume entitled "Probenahme von Erzen und anderen metallhaltigen Verhüttungsmaterialien."

The object of the book is to provide standard methods of analysis in order to facilitate agreement between buyers', sellers', and referee analysts. The first brief chapter states the general rules which should be observed by, and the information which should be provided for the guidance of analysts in cases where disputes are liable to arise. The subsequent chapters deal with the various non-ferrous metals in turn, these being arranged in alphabetical order. The chapters are subdivided, and generally give in turn:—(*a*) the selected methods of determination, (*b*) the methods for separating the metal, (*c*) the examination of special materials, and (*d*) a brief appendix explaining the important points in the previous descriptions. This arrangement, however, is not strictly followed in every chapter, so that in some cases the advantages of uniformity are lost.

The brief chapter on corundum seems somewhat out of place, as it might well have been included under the heading of aluminium. The new chapter on beryllium is of interest and it includes methods for the analysis of beryllium-rich alloys with aluminium, copper, iron, and nickel, as well as the determination of small quantities of beryllium in copper which has been deoxidized with that metal. The chapter on the precious metals becomes slightly involved, as it includes silver, gold, platinum, and palladium and gives a brief reference to iridium. There are, however, distinct advantages in dealing with all these metals in one chapter, as the general methods of determination are so closely allied. The final chapter treats, at some length, with the analyses of the ores and ferro-alloys of chromium, molybdenum, vanadium, and tungsten. Having made so close an approach to the realm of ferrous materials, it is to be regretted that the scope of the book has not yet been enlarged to include iron, steel, and other allied ores and products. A very complete index facilitates rapid reference.

The book should prove a useful contribution to the literature of analysis, being both clear and concise in its form of expression. A vast amount of information is provided in a small space, and, although it is intended for the use of those who are familiar with the processes of metallurgical analysis, it should prove equally valuable to others who are less conversant with the subject.

C. W. DANNATT.

Probenahme von Erzen und anderen metallhaltigen Verhüttungsmaterialien sowie von Metallen und Legierungen, mit einem Anhang. Paper covers, octavo, 108 pages. Price 4 RM. Berlin: Gesellschaft Deutscher Metallhütten- und Bergleute e. V.

This little book describes, in detail, the various methods of sampling ores, metals, alloys, and residues. The subject is treated concisely, but in a very thorough manner, and a very large variety of materials is considered. The object of the production is to standardize the processes, and thus to enable the sampler to avoid the possible sources of error. Only hand-sampling methods are described, a few brief references being given to mechanical devices.

The sampling of ores from shipments, wagons, heaps, sacks, etc., is first considered, and the reduction of the bulk sample by coning and quartering, or by shovelling, is followed through to the preparation of the laboratory sample and the selection of the moisture sample. The sampling of metals and metal residues is treated on similar lines, starting with the identification of the consignment and finishing with the withdrawal of the laboratory sample. The determination of moisture and of ignition loss is also described. A blank form for a sample report serves to illustrate the various important items which should be observed and recorded by the sampler.

Special methods for sampling metals, scrap, residues, ashes, etc., are then dealt with under various headings, these materials being divided into 40 different classes, each of which is separately considered. A short appendix indicates the weight of various materials which is requisite for a laboratory sample, and a table gives the details of the mesh of standard screens. All this information has been compressed into 70 pages, but the arrangement is such that reference is easy, although a detailed index is not given.

The remaining 38 pages contain the principal appendix, which consists of three parts. The first of these gives the commercial tolerances for the impurities and the dividing limits for analyses of metal residues and similar materials. The second part gives the conditions of sale for the German trade in old metals, scrap metals, and ingot metals. The book concludes with the third part, which gives a translation of the American Standard Classification for Old Metals. (Circular L, of the National Association of Waste Material Dealers, Inc.)

The book is presented in a handy form, and is printed in clear type. It should prove of value to all those who are interested in sampling or in the metal trade, and the appendix forms a most useful supplement, not only to this volume, but to the sister volume, "Ausgewählte Methoden für Schiedsanalysen." The two books make a reliable reference work on the production of which the Association is to be warmly congratulated.

C. W. DANNATT.

A Practical Handbook on Water Supply. By F. DIXEY. Cloth, octavo, 571 pages, illustrated. Price 21s. London: Thomas Murby and Co.

This is a welcome book, written from the point of view of assisting those who, though inexperienced in such work, are faced with the necessity of developing water supplies for European and Native settlements, as well as for the smaller administrative, and missionary, stations. It goes beyond this, however, and the geological aspect of water supply is treated in sufficient detail to make the book of distinct value to engineers. Everyone who has had practical experience of water supply knows that a general source of friction is the inability of the average engineer fully to appreciate the reasons which determine the advice of geologists. For this reason the book can be recommended to both engineers and geologists concerned with water supply, as possibly it may help to a better understanding of the problems of each, and the difficulties with which each has to contend.

MURRAY STUART.

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

LETTER TO THE EDITOR

The Scientific Fundamentals of Gravity Concentration

SIR,—The review of this book by Professor B. W. Holman in your October issue would seem to suggest that the art of ore dressing had been elevated to a science and that the work is a valuable contribution to an extensive literature already in existence. During the last couple of years, especially, Continental writers have concerned themselves very much with the mathematical treatment of this subject and their work has attracted attention in the United States (*vide* the Ore Dressing section in "Roush"). The translation of the present book is an instance of this, but surely should not be taken as vouching for its practical value. Its reading will arouse much sympathy for the author, whose environment and language seem to have isolated him completely from modern thought and practice. The entire treatment he gives to the subject is based upon Rittinger's and Stokes' laws for falling bodies in water, as usually stated, and as verified by experimental proof. But this proof, mainly by Richards, did not verify these laws in their entirety; the constants were found to be different from those which the laws would predict, although the general form of the equations was satisfied. This was due to the neglect of a factor which was not even suspected to exist at the time, but which has since revenged itself by almost driving gravity concentration from the field.

And yet the laws of concentration can be stated in mathematical form, although this involves an incursion into a branch of mathematics which has been almost entirely neglected, except by a few French mathematicians. Here will be found, not only adequate expressions for the operations of

dressing, crushing, and classifying, but applications in electricity and general engineering.

As things stand we must expect to meet with this sort of thing ("Graphical and Mechanical Computation," by Professor Lipka, of the Massachusetts Institute of Technology) : "As the first three points do not lie very near this straight line, we shall use only the last five," etc., and, "Omitting the first three values of H, and dividing the remaining data," etc. In short, if the facts don't fit the mathematics, so much the worse for the facts.

R. T. HANCOCK.

Camborne.
December 1.

NEWS LETTERS

JOHANNESBURG

December 3.

Far West Rand.—Drilling operations are being carried out by Sir Thomas Cullinan in the neighbourhood of the Middelvlei Inlier situated on the ground of the Middelvlei Black Reef Gold Prospecting and Development Syndicate, on the farm Middelvlei No. 6, south-west of the Randfontein Estates. A large amount of development was done on Middelvlei No. 6 by Mr. Stubbs, then Sectional Manager of Randfontein, on behalf of the late Sir J. B. Robinson. An incline shaft was put down approximately 800 ft., and some six drives were made in either direction, but owing to the low values encountered, nothing came of the venture. The boring at present being done by Sir Thomas Cullinan is to prove the continuity and value at depth of the Main Reef, and should his efforts be successful, he will have proved an enormous area of Main Reef ground at comparatively speaking shallow depths. It is understood that one of the Rand's leading geologists has made a report on the farm Luipaardsvlei No. 10, which is situated east of Middelvlei and south of Randfontein Estates. The report is said to show that the Main Reef Series lies at a depth of 8,000 ft. vertical on the south eastern boundary of Luipaardsvlei and an estimated tonnage of 7,000,000 tons is said to be near the surface on the western portion. If this contention is correct, then a large portion of Middelvlei No. 6 should contain Main Reef at workable depth, providing, of course, that this series is not cut off by the Witpoortje and Roodepoort Faults. Surveyors of the New Consolidated Goldfields Group have recently visited the Western Areas' property, over which the group holds a prospecting option, to carry out preliminary work. Western Areas was formerly known as the Western Rand Estates.

Eluvial Gold Discovery.—An eluvial gold occurrence has been discovered on a farm near Kaapsche Hoek, in the Eastern Transvaal. The gravel carrying the gold lies some 30 ft. below the surface. An area of 506 claims has been taken up and a company has been formed to work it. It is reported that 14 claims have been proved to contain the gravel deposit, which varies in thickness from 3 ft. to 15 ft. One hundred loads of the gravel were washed and 44 oz. of gold were recovered. The gravel is present in large quantities and, with the cheap labour of the district and ample supplies of water, working conditions are highly favourable. Machinery of the Klondyke type is now being built locally and a pumping plant will be installed. The gold is very coarse and nuggety and many of the nuggets exceed an ounce in weight.

Ancient Tin Mines Discovered.—On Cornucopia farm, about two miles from Rusapi township, Southern Rhodesia, an archaeologist has discovered the site of some ancient tin workings which derive their importance from the fact that they are associated with a region supposed to be the locus of the ruby and silver mines mentioned in the writings of a Portuguese priest who visited this country in the 15th and 16th centuries, and whose works on Monomotapa are to be found in the archives at Lisbon. The actual ancient workings, some 20 in number, are spread through a granite range of hills in an area of about 80 acres and apparently form a series of pipes, all of which were worked by the ancients. Surrounding these pipes, are many thousands of grinding stones, some worn into the solid granite to a depth of several inches. In conjunction with these are large areas of broken pottery, showing that the ore, which is very soft, was ground on the rocks and carried down to the water in the pots for washing purposes. Several ancient smelters have been unearthed, and also several lumps of the smelted tin. What commercial value the find has cannot be decided until the workings are cleaned out, but the surrounding country, which has been pegged, shows small

quantities of tin by assay and in the pan. The whole area is fortified, and from a casual glance one would be inclined to put the date as not very ancient, but there might easily be two periods, as some workings have enormous trees growing from them and others are fairly clear of vegetation, while some smelters appear to be of much greater age than others. From observation and the number of grinding stones on the rocks, a huge population of natives, probably slaves, must have been connected with the operation.

Higher Extraction at Glynn's.—A solution of the metallurgical difficulties at Glynn's Lydenburg is now in sight. After many months of experiment and research at the chemical laboratory of the Central Mining and Investment Corporation at Johannesburg, under the direction of the consulting metallurgist, a flotation scheme was evolved, which has since been incorporated in routine slime treatment methods with remarkably successful results. This method by which the harmful graphite is removed from the slime in the collectors and run to waste is not applicable to the sand treatment, and in the circumstances the best metallurgical results would be obtained by discarding sand treatment entirely and adopting an all-sliming process. Several months and a substantial cash expenditure would be required for such a programme and, particularly in view of the company's difficult financial position, an investigation has been necessary in considerable detail, including the study of comparative estimate of cost and resultant yield. This stage is nearing completion, and the board hopes shortly to have before it an approved scheme which it will be able to authorize. The expenditure involved by the elimination of sand treatment in favour of all-sliming would probably be between £10,000 and £12,000—an amount which should be returned within a period of about two years by the resultant additional recovery of gold from the ore treated. The percentage of extraction for the past financial year was 78·65. The average for the final quarter of the year was below that figure. In August of the current year the percentage was 77·31 ; in September, with the incorporation of the flotation scheme in the slime treatment, it improved to 85·43, and in October it was 87·6.

Sherwood Starr's Ore-Body.—Contrary to the experience of most gold mines in Southern Rhodesia, the Sherwood Starr was never exploited by the ancients. There are at any rate no trace of old workings to be observed on the property. The ore-body may be regarded as an occurrence of hard jasperlite, associated with greenstone schists, and a clay seam of irregular dimensions probably of intrusive origin. On the 9th and 10th levels the width of the ore-body contracted and the strike lengthened, but it has subsequently widened out very considerably. The latest assays on the 12th level are higher than on the preceding one and this fact augurs well for the persistency of the ore-body in depth and the maintenance of its gold content.

X-Rays Used in Mines.—At a sitting of the Low Grade Ore Commission it was revealed that thousands of feet of fuse have been X-rayed at different times to check the allegation that defective fuses are a frequent cause of loss of life underground. Miners have often alleged that a " running fuse "—one defectively made so that the powder burns so fast that there is no time to get out of the danger zone—is the frequent cause of accidents. Therefore the aid of the X-ray was sought, and never once has it detected a foot of " running fuse." The manufacture of fuse is now so carefully supervised that absolute safety had been attained. In the effort to remove that constant bugbear of the underground worker—the misfire—resort has been made to the most extraordinary devices. One method described to the Commission by Mr. F. G. A. Roberts (technical adviser to the Chamber of Mines), was the wrapping of cartridges in soluble coloured papers, so that when the working face was washed down after blasting and a splash of a certain colour appeared, it would be known that it meant the presence of an unexploded charge. For various reasons that plan failed, and since then other experiments have been made. One was the impregnation of the cartridges with certain pungent odours, which would spread when water came in contact with an unexploded charge.

BRISBANE

November 18.

Mount Isa's Position.—The General Manager of Mount Isa Mines, Ltd. (Mr. J. Kruttschnitt) was in Brisbane a few days ago, on his way to Sydney. The extremely low point reached by the prices of lead, silver, and zinc had caused some public anxiety as to the position and probable future operations at the Mount Isa mines, but on this point the General Manager has

given some very reassuring information. He says, for one thing, that the position, from the point of view of the shareholders, is quite satisfactory. The ore contents of the various lodes, it is affirmed, are fully up to expectations, and the whole of the operations are being conducted smoothly. There is now being treated 36,000 tons of ore per month, and there is being produced monthly 3,300 tons of bullion, which averages about 99% lead and 50 to 60 oz. of silver to the ton. This represents an approximate value, on the basis of the prices ruling at the time, of £42,900 a month. Lead was then £13 8s. per ton ; now it is over £11 10s. Silver, too, has taken a big jump in the past week or so, rising from about 1s. 5½d. to over 1s. 9d. per ounce. Mr. Kruttschnitt added that notwithstanding the fluctuations to low ebbs of metal prices, it had to be remembered that Mount Isa is essentially a low-grade proposition, and mass production, with economical methods, made the outlook quite satisfactory. The rise in the price of lead, even to £13 8s., he stated, had encouraged the company to put the whole of the plant on the ground into operation as soon as possible. Within the next two months it is expected, by putting to work additional sintering and smelting equipment, to increase the output to about 4,000 tons of bullion each month ; while within six months probably an output will have been reached of about 5,000 tons of bullion monthly. On the price basis of £13 8s. for lead, this production will represent a value of, roughly, £67,000 per month, and will be the result of the employment of the whole of the present plant. Plans for further extensions of operations are to depend on the course of the metal prices, which during the past month have been distinctly on the upgrade. At present about 1,050 men are employed, and to date the company has spent £3,375,000, of which 85% has been expended in Australia. The aggregate of the under ground workings is, approximately, two miles.

Mount Isa Production and Operations.—Official returns show that in October the bullion produced at Mount Isa contained 3,296 tons of lead worth £43,577, and 165,993 oz. of silver, valued at £11,757. The quantity of ore treated at the mill in the same period was 36,691 tons, and the concentrates therefrom, 7,171 tons. The immense dumps of rich ore deposited at the Lawlor shaft, Rio Grande section, during development work in that area are reported to be now all used up, and consequently more ore will henceforth be broken below. The company is paying £30,000 monthly in wages, and £15,000 each month in railway freight. The Government mining warden in the Cloncurry district, in reporting for October, states that, owing to the handling of a mixture of sulphide and carbonates, some new metallurgical problems had to be worked out in connexion with the sintering plant and the furnaces since the opening of the treatment plant in July, but that these problems have now been solved. The output has practically reached the limits of the sintering equipment, but another sintering machine has been ordered and is expected to be in operation by next March. In the mining section, the seven glory-holes on the Black Star lode have been operated continuously. but no carbonates were mined during the month on the Black Rock lode. Development work has been kept in hand as usual. Two extra diamond-drill holes, placed to test the southern extension of the foot-wall lode, have been finished, and a third hole is now being drilled. Preparations for extensions of stoping to other lodes are approaching completion ; also for the mining of a small tonnage from a pyritic ore-body in the hanging-wall.

Cloncurry Minerals.—The returns of copper produced in the Cloncurry mineral field for October have been much reduced by the stoppage of work in the three mines leased from the Mount Elliott Company (Mount Oxide, Dobbyn, and Orphan), and the privately owned Trekelano mine, near Duchess. In the three first named the men are still " out " because they will not work at a reduced wage, and, as these mines have been the principal producers of copper ores for treatment at the Chillagoe State smelters, these works are threatened with being hung up for want of supplies—a result that would be a severe blow to the miners of the Herberton and Chillagoe districts.

Mining Concessions.—About 12 months ago an Act was passed by the Queensland Legislature ratifying three agreements granting concessions over mining areas in North Queensland. There has been some criticism as to the little that has been heard of any practical results following since then. The Minister for Mines (Mr. A. E. Atherton) while defending the granting of these concessions, admitted that the concessionaires had not done all that had been expected of them. He said that one of them, Mr. Alexander Macdonald, had apparently not been able to

raise the capital he ancitipated getting, but seemingly he had raised some, as he is employing a number of men about 10 miles from the concession areas. The Government, however, is making more stringent regulations for the issue of these concessions. People who want them—and there are still numerous applications for such—will have to put up substantial deposits to compel them to do something within a given time or forfeit the money put down. A company which has obtained an area on the Oaks goldfield, in the far North, has lodged £1,000 as a guarantee of good faith ; while negotiations are in train for an area of 2,000 acres, in which case a deposit of £10,000 is required.

Coal Trade.—Trouble is naturally brewing in Queensland over the action of the Commonwealth Government in granting a bonus of 1s. a ton on coal exported from New South Wales, and not extending the same help to the coal industry in other States. In its endeavours to obtain an overseas outlet for coal from the Bowen field, in North Queensland, this State has to come into direct competition with Newcastle coal, and the Queensland Government is now asking that the subsidy should extend to this part of the Commonwealth. At the present time the Mines Department is endeavouring to obtain an order for 10,000 tons of coal per month for export overseas from the Bowen State mine, and the selling price has already been reduced to help in the competition with other States. It has transpired that the Bowen mine some time ago lost a contract for supplying coal to Noumea, New Caledonia, through New South Wales mines underquoting them to the extent of 6d. a ton. Notwithstanding that all the coal required for Mount Isa is being obtained from the Bowen field, and is declared by the General Manager of that company to be of a suitable quality, the output each month is decreasing, and the miners are working short time.

Gold Prospecting and Production.—Active prospecting for gold, with Government assistance, continues to be carried out in Queensland and other States. Although the results have so far been small, there have been material increases in production as reported each month, and news of further important finds frequently comes to hand. The latest of these reports is that of a discovery of what is described as the richest gold reef which has been found in Victoria for many years, and which is being opened up near Combiendar, Gippsland. The first crushing of two tons of quartz yielded more than 120 oz. of gold, valued at £720. While the State Mines Department officials, who know the country, say that the gold is rich but patchy, and is in scrubby, difficult country, reports from the locality are that there is a well-defined reef, which is widening the more it is opened out. At the same time, encouraging reports are being received of indications of a distinct revival of gold mining on the historic Bendigo field in Victoria, and in the old fields of Charters Towers and Gympie, in Queensland. In a letter which has been received by the Premier of Victoria (Mr. Hogan) from the Prime Minister (Mr. Scullin), it is stated that arrangements have been made by the Commonwealth Bank enabling Australian gold producers to obtain world prices for all gold won by them. The Bank will accept the gold as the agent of the producer and ship it abroad for sale, paying the producer the proceeds of the sale of the gold, including the ruling rate of exchange, but subject to a deduction of 25s.% for freight, insurance, and other charges.

VANCOUVER

December 8.

Portland Canal.—Some new ore-bodies lateral to the main ore zone have been discovered at the Premier mine, as a result of active prospecting work carried out by Premier Gold Mines on the upper levels. The company has also been carrying out diamond-drill exploration on the Salmon Gold group. Development on the Big Missouri is being continued by the Consolidated Mining and Smelting Company in a systematic search for ore shoots upon which the economic value of the low-grade ore-body depends.

Atlin.—Diamond drilling has been carried out on the Whitewater and adjoining groups by Noah Timmins, Inc., and some encouraging results have been obtained. It is expected that further development will be commenced next year. Alaska Juno Gold Mining Company acquired an interest in the Silver Bird, Golden Star, and Mineral Mountain groups, and has commenced a programme of prospecting work.

Usk.—Columario Gold Mines, Ltd., is considering more extended development and the erection of the first unit of the mill as

a result of a favourable report made upon its property.

Cariboo.—The prospecting development work that has been carried on for some years on the gold-quartz veins near Barkerville, by the Cariboo Gold Quartz Co., Ltd., has resulted in proving some promising features, although no ore reserves have yet been blocked out. One of these features is the existence of free gold in the veins below the zone of oxidation and further development in depth appears to be justified.

Bridge River.—The Pioneer vein has been proved to extend laterally on the 8th level for a distance of 1,860 ft., and the plans for development from a new three-compartment shaft to a depth of 3,000 ft. below the surface are well under way. The average grade of the ore milled during the past six months was $20·00 per ton, and the production for the year is estimated to be around $650,000. With the completion of the new mill next year, it is to be expected that production will reach a value of $1,250,000 per year. The successful operation of this property has led to great activity in the area, and several adjoining properties are under active development. In particular the Lorne, adjoining the Pioneer, is expected to come into production next year with the completion of a 100-ton treatment plant now approaching completion.

Boundary.—A shipment of about 50 tons of high-grade ore, recently discovered as a result of development at the Union mine, is said to have yielded a net return of $43,178, assays being as follows :—Gold, 41·05 oz. ; silver, 18·65 oz. ; lead, 7·65% ; zinc, 9·05% ; and copper, 0·98%. The property is financed by the Hecla Mining Company of Wallace, Idaho. The find is a faulted westerly extension of the ore-body in the upper levels. The width varies from 4 to 10 ft., and has been proved to extend for a distance of 165 ft. as far as development has yet been carried. The result of this discovery has led to renewed activity in this camp and re-opening of the old workings on the Homestake group has resulted in the discovery of some high-grade gold ore.

Nelson.—Development of the Reno mine on Sheep creek is meeting with satisfactory results, the gold-quartz vein has been opened up for a distance of 400 ft. on the No. 4 level showing values of $40·00 per ton over an average width of 2 ft., and it is reported that the vein has been again cut in the No. 5 cross-cut tunnel at a further depth of 270 ft. Production for the month of October was valued at $21,000 in gold bullion.

Annual Western Meeting of Canadian Institute.—The Annual Western Meeting of the Canadian Institute of Mining and Metallurgy was held in Vancouver from November 25 to 27, in conjunction with the Mining Association of British Columbia, and proved to be an event of more than ordinary interest. The meeting was opened by the Hon. W. A. Gordon, Minister of Mines for the Dominion, who came over from Ottawa with his Deputy Minister, Dr. Chas. Camsell and several leading representatives of the mining industry in Eastern Canada. The Hon. W. A. MacKenzie, Minister of Mines in the Provincial Cabinet was also present. Subjects of local and general interest were presented and discussed, and a considerable amount of attention was given to the study of economic problems. Other salient features were the following :—Details were given by W. G. Hatch of the remarkable reduction in costs effected by Britannia Mining and Smelting Co., as a result of which it has been made possible to continue operations on ore carrying a fraction over 1% copper at the existing critical market price. During the month of October, 1931, an amount of 6,248 tons dry ore was milled, at a direct milling cost of 18·27 cents per ton, or a total cost, inclusive of primary crushing at the mine and of flotation process royalties, of 20·48 cents. Interesting aspects of the mining situation in British Columbia were covered by the Provincial Mineralogist in his addresses before the Mining Institute. The estimated production of all mineral products for the year 1931 is valued at $36,000,000, representing a decline of about 36% as compared with 1930, but the actual quantity production will amount to 82% of the province's record. These figures constitute a striking tribute to the determination and ability of executives to reduce costs in order to meet the situation created by low market prices. A comparison of production in gold, silver, lead, and zinc is as follows :—

1930.		1931 *(estimated)*
3,475,811·00	Gold $	3,500,000 00
11,289,171	Silver oz.	8,700,000
319,199,752	Lead lb.	256,000,000
250,287,306	Zinc lb.	208,000,000

The production of placer gold for 1931 is estimated at a value of $230,000, as compared with $152,235 in 1930, reflecting the marked increase in placer mining activities that were

conducted, for the greater part, on a small scale. Coal production will show a reduction of about 10%, due to the effect of hard times upon domestic and commercial consumption. In connexion with lode-gold mining possibilities, to which great attention is being given at the present time, Mr. Galloway said that by far the greater part of the past production had been derived from base-metal ores, essentially replacement or contact ore-bodies, but quartz veins of the gold-silver type were more widely distributed and were to be relied upon for future production, more particularly in the Central belt, where all the important placer areas occur which have been responsible for an output valued at $79,000,000. More intensive investigaton of the gold-quartz veins of the province is justified. The known reserve of lode-gold in the province may be estimated at 700,000 oz., with an additional amount of 700,000 oz. as being probable in connexion with the extension and development of known ore-bodies. This probable reserve, valued at $30,000,000, represents only eight or nine years' supply at the present rate of production, but it is well to remember that no greater reserve has ever yet been indicated, and still a production valued at $141,000,000 has been made during the past 38 years, since the commencement of lode-gold mining in the country, so that there is no need for discouragement.

TORONTO

December 20.

Gold Production of Ontario.—The monthly report of the Ontario Department of Mines for November gives the value of the output of the gold mines, exclusive of exchange, as $3,666,270 as compared with $3,748,100 for October. The six producing mines of the Porcupine area yielded $1,579,296, from the treatment of 263,163 tons of ore, as compared with the October output of $1,671,035 from 262,567 tons. The production of six mines in the Kirkland Lake district amounted to $1,949,816, from 148,500 tons milled, as against $1,981,189, from 151,982 tons. Three mines in north-western Ontario also contributed to the total of production for the month.

Porcupine.—The mill of the Hollinger Consolidated is treating an average of 4,500 tons daily, with a recovery of about $6·30. The extraction of ore from the open-cut has been discontinued, owing to the setting-in of cold weather. Underground development on the 2,800 and 3,000 ft. levels has disclosed large tonnages of good ore and high-grade ore sections have been encountered in other parts of the property. The company has acquired large interests in the new Swayze goldfield, where it now controls two blocks of well-located land. Production by the Dome Mines for November amounted to $251,685, as compared with $285,733 in October, being the lowest yield for any month of the year, due to the loss of tailings. It is hoped to avoid this loss by the new treating process, for the installation of which additions to the mill are being made. Work is being rushed with the object of having it in operation as soon as possible. McIntyre Porcupine reports net earnings, before depreciation, for the quarter ended Sept. 30, of $543,597, bringing the net earnings, before depreciation, for the six months to Sept. 30 to a total of $1,005,068. At the annual meeting of the Vipond Consolidated, it was stated that development during the year had not brought about any outstanding results, although there were encouraging indications, and it was expected that the programme would reach definite results within the next few months. During the year some $200,000 was spent on mine development as against $89,000 in the preceding year and, notwithstanding this outlay, the company showed a profit, before deduction for income tax, of $135,000. The shaft has been carried down to 1,450 ft., where low-grade lenses of ore were encountered in lateral work, and rising is now being done in this area. The Coniaurum during November produced more gold than for any previous month. Development work is meeting with satisfactory results, and the grade of ore shows improvement. Before the shaft can be put down below the 2,500 ft. level, a new hoist will be necessary, as the one now in use is working at the limit of capacity. Work will shortly be started by the McMahon Gold Mines, whose property is located south of the Vipond.

Kirkland Lake.—The Lake Shore is treating an average of 2,350 tons of ore per day, with a recovery of about $15·50 per ton. Equipment recently installed to reduce the tailing loss is now in successful operation. Development on the lower horizons continues to increase the ore reserves. On the 2,325 ft. level the first cross-cut through the ore-zone

cut a stretch of 35 ft. of high-grade mineralization. Work also is proceeding successfully on the 2,450 and 2,575-ft. horizons. The Teck-Hughes is energetically carrying out its programme of deeper mining. The shaft now being put down from the 30th level has reached a depth of about 80 ft. and the first level will be established at 625 ft. or 4,200 ft. from surface. Sinking also is underway on the No. 2 winze, which is now nearing the 33rd level. The ultimate depth of the shaft and winze will depend largely on results obtained as work proceeds downward. Levels will be established at intervals of 125 ft. Wright-Hargreaves is gradually improving its milling equipment, with the object of materially increasing production. The crushing plant is now operating on a basis of 825 tons of ore daily, the storage-bin capacity is being enlarged to 1,500 tons, and the flotation plant addition of 50 tons is nearing completion. This equipment will be used until next spring, when it is understood a new mill will be erected or the present mill enlarged to handle 1,500 tons of ore per day. Good ore is being located in the south vein system on all the five bottom levels, while the north vein system is being opened up on the 2,400 and 2,550 ft. levels, and has just been encountered on the 2,700 ft. horizon. The shaft of the Barry-Hollinger is exected to be put down to the 2,000-ft. level before the end of this month. A level will be established at this point and a cross-cut run to the vein. A cross-cut will also be run at the 1,875-ft. level. Ore development has latterly shown marked improvement in width, length, and values. At the Sylvanite, the shaft has now reached a depth of 2,800 ft., and its objective of 3,050 is expected to be reached by the end of January. Levels are being established at intervals of 125 ft., which will be opened up as soon as shaft sinking is completed. Stoping operations from the No. 4 shaft are putting ore in sight running in value much higher than the general mine average. In its development work on the bottom workings, Kirkland Lake is meeting with outstanding success. A considerable body of ore has been indicated recently which will average better than $30 to the ton in gold, while smaller sections give still higher values. Explorations are being carried out on the upper levels for new veins and shoots, and some good discoveries have been made. Lakeland is meeting with encouraging results from lateral work on the 150 ft. horizon, where two veins have been encountered, one of which yielded $7 per ton over a width of 8 ft., and the other, $14 over 4 ft. The shaft is to be put down to 600 ft. The Moffatt-Hall is opening the 425-ft. level, which is expected to yield ore of a good grade. Special attention will be given to a promising vein which entered the shaft at about 400 ft., and is still showing in the shaft.

Sudbury.—The construction work involved in the expansion plans of the International Nickel Company has been completed by the Fraser-Brace Engineering Company. The last jobs, which were completed toward the close of November, were the Orford separation plant at Copper Cliff and the new headframe and surface works at No. 4 shaft, Frood Mine. The construction programme occupied over four years and involved an expenditure of some $40,000,000 for material and $6,000,000 in wages, and at one time as many as 4,000 men were employed in the work. The International Nickel Company is maintaining the policy of restricting its output in accordance with the demands of the market and maintaining active research to discover new uses for nickel. It is understood that an agreement has been reached, whereby United States interests will take the entire nickel production from Falconbridge Nickel Mines next year. It is officially stated that Falconbridge has been disposing of about 55% of its nickel output, and now has about 1,360 metric tons on hand at the refinery in Norway. All of the copper produced has been sold. Under the proposed plan the company will have a market for its entire production. There is every indication that gold mining will before long become one of the leading industries of the district. As a result of the recent discoveries and consequently favourable geological reports from departmental officials, a new area, to be known as the Sudbury Gold Belt, is seeking recognition. This term will henceforth apply to the area lying between the main lines of the Canadian National and Canadian Pacific Railways. At the present time activity in this area is centred in two sections, one in the vicinity of Three Duck Lake and Schist Lake in Yeo and Chester Townships, and the other in Swayze, Denyes, and Dore townships, about 35 miles to the north west. Geological examination of the intervening territory has shown good prospecting possibilities, and some isolated gold discoveries have been

reported. Some prospecting has been done west and south-west of the Swayze find. Assays taken from the property of the Three Duck Lake mining partnership indicate high values in gold on surface. Many companies are preparing to conduct active exploration and development in this area as soon as the spring opens.

Rouyn.—The Noranda reported a net profit of $2,405,813 for the nine months ended Sept. 30, which enabled the directors to declare an interim dividend of 50 cents per share, involving a total payment of $1,119,886. While the company has been forced to take reduced earnings as a result of the low price for copper, it has a source of income from gold and silver that is more than sufficient to tide it over the present unsettled conditions in the copper markets. It is officially stated that gold is being produced at the rate of about $5,000,000 per annum. The copper output is also being maintained at the former rate. While the mine is reported to have some 100,000 tons of ore running $35 per ton in gold, this ore is not yet under development for milling purposes. Development and exploration are being continued on an extensive scale. A diamond drill station has been established on the 2,500-ft. level near the No. 3 shaft, a number of deep holes being put down to a depth of about 4,000 ft. The No. 4 shaft is being deepened to 2,500 ft., and extensive lateral work is under way on the various levels. Drilling is also being carried out on the Chadbourne property of the company with favourable results. The company has taken an option on the holdings of Prospectors' Airways on the boundary of Pascalis and Senneville townships and now holds about 1,000 acres in this district. The Waite-Montgomery will shortly undertake a diamond drilling campaign, involving the sinking of a number of deep holes in order to ascertain mineral conditions at depth. The Siscoe gold mine is producing at the rate of about $70,000 a month and now has sufficient ore indicated to keep the mill going at the present rate of operations and the current grade of ore for a period of more than two years. Additions to the mill are under way which will increase gold production. At the Granada gold mine much new equipment is being installed in prepartion for greatly enlarging the scale of operations. The new power transmission line is expected to reach completion by the New Year. A contract has been awarded for 4,000 ft. of diamond drilling.

Patricia.—The mill of the Howey gold mine is treating about 700 tons of ore per day, and during November produced gold to the value of approximately $81,250, which indicates an operating profit of approximately $30,000. Development continues to show good results, ore values being well maintained. Officials estimate that production costs will run less than $3·75 per ton. A new tube-mill has been completed and put in operation. Casey Summit Gold Mines, which holds a property of about 2,000 acres, is looked upon as an early gold producer. The company purchased the equipment of the Bobjo Mining Company at Confederation Lake, which was installed on the property last spring. A shaft has been put down to 150 ft. and a level established at 125 ft. The vein has been driven on for 140 ft. and channel sampling every 5 ft. shows average values for the length of vein so far exposed of $18·15 per ton in gold across an average width of 3·2 ft., with the south face of the drift in $40 ore.

Manitoba.—The Hudson Bay Mining and Smelting Company, which began shipments from their plant at Flin Flon on November 1, 1930, have during the year shipped 520 cars of blister copper and 385 cars of zinc. Shipments have steadily increased during the year, when a peak was reached in October with 118 cars. Many of these cars were for export from Montreal, but others were billed to the refining plant at Copper Cliff and to other smaller plants in Ontario and Quebec. In addition to the production from the Flin Flon mine, an aggregate of 444 cars of concentrates have been shipped to the smelter at Flin Flon by the Sherritt-Gordon Company since operations were commenced at Sherridon in April. Future operations on the Sherritt-Gordon mine, it is officially announced, will depend entirely on the price of copper. It was originally planned to produce copper at the rate of 8½ cents per lb., but in actual operation the cost has been reduced to 6½ cents. Operating costs at the mine have been reduced to $2·35 per ton and the total cost, including freight and smelting and refining costs, is $4·15 per ton. While it was intended to handle 600 tons daily, 900 tons and better is being milled. Production has been around 1,700,000 lb. of refined copper per month, and the production of gold and silver amounts to $15,000 monthly. Gem Lake mines in Central Manitoba has made its first shipment.

PERSONAL

W. Baddeley Adams has left for Abyssinia.

Reginald Allen is home from Colombia.

G. C. Barnard is returning from the Belgian Congo.

W. E. Barron has left for Northern Rhodesia.

A. Boyes is returning from Sierra Leone.

R. P. Brodie is home from Nigeria.

J. V. N. Dorr has been elected President of the American Institute of Chemical Engineers for 1932.

Maurice Gregory has left for Abyssinia.

J. Vernon Hobson is returning from India.

A. J. Kelman is home from Malaya.

J. V. Lake is leaving South Australia for New Zealand.

Messrs. Mackness & Shipley have removed to Parliament Mansions, Orchard Street, Victoria Street, Westminster.

Dr. W. S. McCann has been appointed joint manager of New Consolidated Gold Fields in South Africa.

Edward H. Robie has been appointed assistant secretary of the American Institute of Mining and Metallurgical Engineers.

Charles Salter is returning from the Straits Settlements.

F. S. Sinnatt has been appointed Director of Fuel Research under the Department of Scientific and Industrial Research.

G. E. Stephenson is returning from Cyprus.

G. L. L. Stone has left for Greece.

M. H. Thomas is returning from West Africa.

A. H. E. Turner is leaving for the Gold Coast.

H. J. Winch is home from India.

Donald D. Henderson died on December 19, at the age of 59, from double pneumonia, after a short illness. He received his training as an engineer in New Zealand at the time when the gold dredging industry was in its infancy and came to London in 1899. After 3 years with a firm of consulting engineers, Mr. Henderson joined C. J. Inder, the partnership of Messrs. Inder & Henderson having started in 1913. His work carried him to many fields, including Malay, Serbia, and Central America. During the War Mr. Henderson joined the board of Messrs. J. Kirkaldy & Co., of which company he was chairman at the time of his death.

TRADE PARAGRAPHS

James Howden and Co. (Land), Ltd., of Caxton House, London, S.W. 1, is the name by which Howden-Ljungstrom Preheaters (Land), Ltd., will in future be known.

British Standards Institution, of 28, Victoria Street, London, S.W. 1, by which name the British Engineering Standards Association is now known, publish particulars of a new specification for compressed-air receivers.

Ransomes and Rapier, Ltd., of Waterside Works, Ipswich, issue a neat little booklet describing briefly the main products of their organization, which include cranes, winches, and a variety of civil engineering equipment, beside their well-known excavators.

Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, in the December issue of their *Gazette*, have an article describing conveyor motors and control gear for machine mining, which has a special reference to colliery work, but which is nevertheless of wider interest.

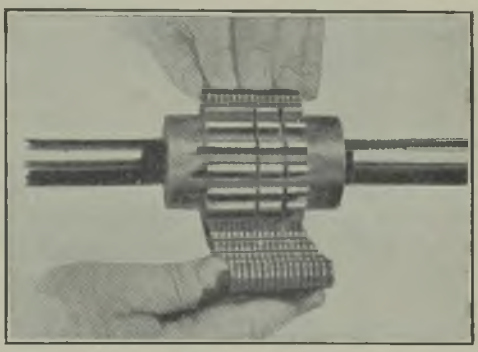
Bureau of Information on Nickel of the Mond Nickel Co., Ltd., of Imperial Chemical House, Millbank, London, S.W. 1, publish a booklet dealing with the mechanical properties of nickel alloy steels, which forms one of the interesting series of technical bulletins from this organization.

Eagle Engineering Co., Ltd., of 45, Pall Mall, London, S.W. 1, issue a leaflet describing the trailers that they manufacture for export and suitable for various transport purposes in different countries. These include 2, 4, and 8 wheel vehicles in capacities ranging from 2 or 3 tons up to 30, 50, and 100.

Yorkshire Electric Power Co., of 36, Park Place, Leeds, invite the attention of foreign manufacturers to the convenience of certain areas in Yorkshire that are suitable for the erection of works, and they point out the proximity of the Yorkshire coal field and relatively of the Lincolnshire iron field.

Lancashire Dynamo and Crypto, Ltd., of Trafford Park, Manchester, is the title by which an alliance of the Crypto Electrical Co., Ltd., of Acton Lane, Willesden, London, N.W. 10, and the Lancashire Dynamo and Motor Co., Ltd., will in future be known. There has been a close association between these two firms for some considerable time.

International Geophysical Prospecting Co., Ltd., of 10–12, Copthall Avenue, London, E.C. 2, inform us that they have been engaged to carry out an extensive geological and geophysical survey of potential oil-bearing lands in North-West Germany. Mr. J. C. Templeton is now on a visit to the territory, where a party is engaged under the direction of Dr. S. Papp.



Morse Flexible Coupling.

Morse Chain Co., Ltd., of Letchworth, send us a catalogue describing their flexible coupling, the essential elements of which are shown in the accompanying illustration, from which it will be seen that two sprockets are mounted on each shaft, and wrapped by an inverted tooth chain easily coupled up by means of chain joint pin with cotter. The coupling is suitable for transmission of from 8 to 158 h.p., at 100 r.p.m. with maximum permissible r.p.m. respectively of 4,200 and 730.

Seismos G.M.B.H., of Hanover, Germany, which is associated with the **Geophysical Co., Ltd.,** of 62, London Wall, London, E.C. 2, have published an exhaustive treatise by Professor Dr. L. Mintrop on the history of the Seismic method for the investigation of underground formations and mineral deposits, which refers to the work of all the well-known authorities and fully describes the

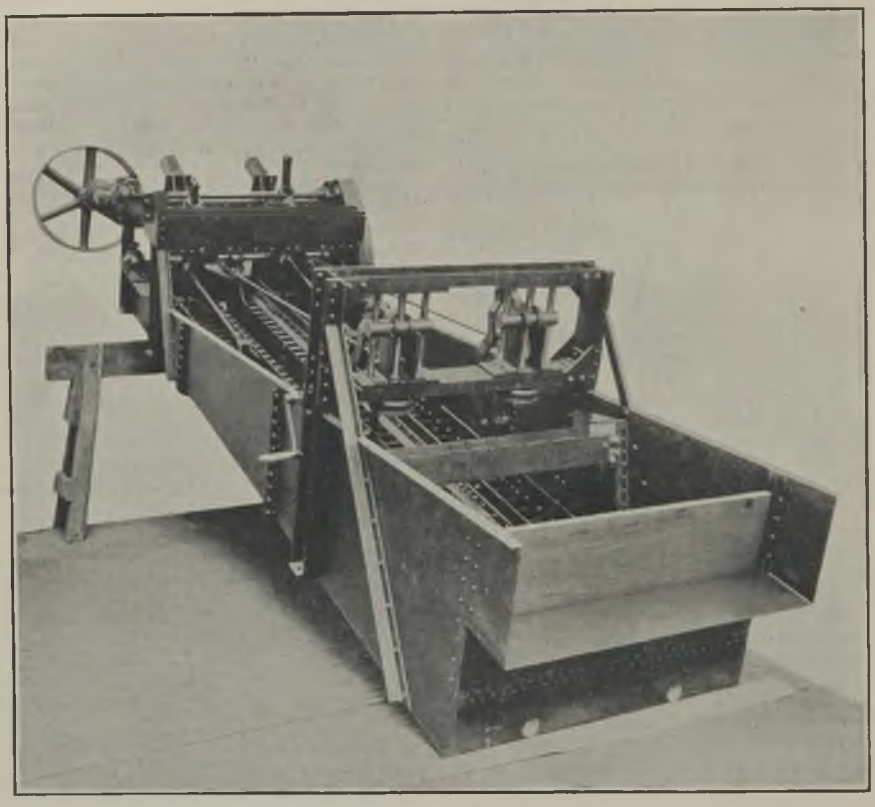
progress that has been made up to 1930 in this important branch of geophysics.

Mining and Industrial Equipment, Ltd., of 11, Southampton Row, London, W.C. 1, report having received the following new orders:—For England: One No. 00 Raymond pulverizer for lead pigment and one 2 ft. by 4 ft. two-surface, type 27, Hummer electric screen for washed shingle. For Scotland: One 3 ft. by 5 ft. one-surface, type 39, Hummer electric screen for fireclay. For Rangoon: One No. 3 Impax pulverizer for bone meal. For Russia: One 2 ft. by 8 in. Hardinge mill for unnamed ore.

Straub Manufacturing Co., Inc., of 507, Chestnut Street, Oakland, California, publish a catalogue of their Rib-Cone portable milling plant, which comprises crusher, elevator, ball-mill, concentrating table, flotation cell, and/or amalgamation plate, together with power plant and transmission equipment as required. These are made in a number of sizes and capacities suitable for different classes of operations, ranging from 5 to 8 ton plants up to 25 to 35 tons, and may be purchased with or without suitable framework for erection.

Wilkinson Rubber Linatex, Ltd., of 1-4, Great Tower Street, London, E.C. 3 (sole concessionaires for Europe of Wilkinson Process Rubber Co., Ltd., of Malaya), have published a booklet giving up-to-date information about the progress made in the application of their Linatex rubber linings suitable for covering those parts of a plant subjected to abrasion, such as launders, pipes, certain pump and valve parts, etc. A new application to which reference has not formerly been made is the use of Linatex for lining skips. Figures are quoted in letters from actual users showing the increased life of these and other parts so lined.

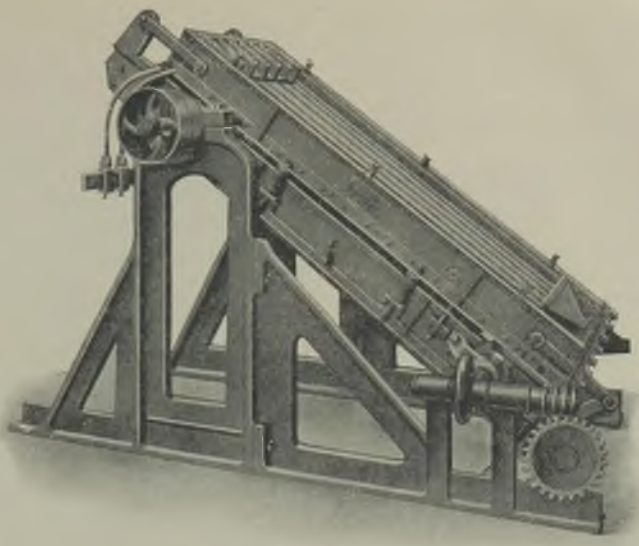
Fried Krupp Grusonwerk A.G., of Magdeburg-Buckau (London Agents J. Rolland and Co., Abbey House, Victoria St., London, S.W. 1), draw attention to their rake classifier which is illustrated in the accompanying photograph. This is a mechanically



KRUPP RAKE CLASSIFIER.

operated classifying machine similar to other units of its type consisting essentially of a trough with one or more pairs of rakes, the driving gear necessary for these, and a cam device for increasing or decreasing the stroke of the rakes, together with an overflow device. The latter, the discharge capacity of which can be readily adjusted by raising or lowering the wooden slats provided, allows of the variation of the grain size of the over-flow material within wide limits.

Wilfley Mining Machinery Co., Ltd., of Salisbury House, London, E.C. 2, issue a pamphlet describing the Wilfley-Williams vibrating screen, which is illustrated here. As will be seen, this is an inclined screen the angle of which may be varied. It is made to vibrate by means of tappet wheels so that each revolution of the driving pulley causes the screen box to rise and fall six times, the height of the lift and fall being regulated by means of buffer blocks. The screen is made in a variety of

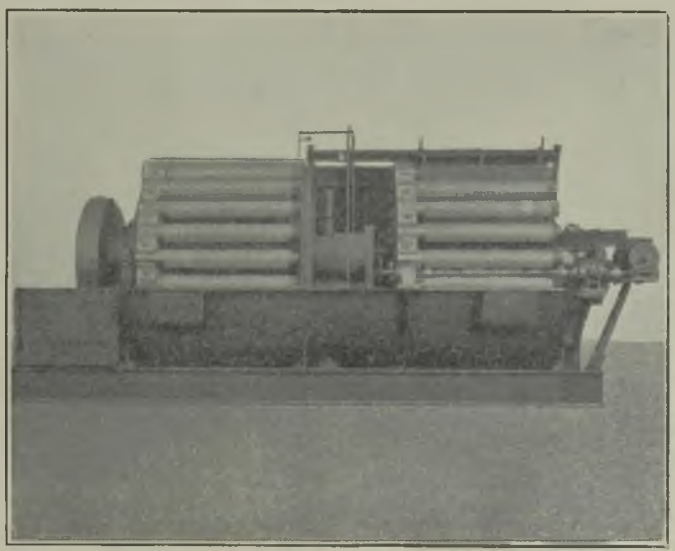


WILFLEY-WILLIAMS VIBRATING SCREEN.

sizes and is suitable for wet or dry screening between ½ in. down to 200 mesh.

The Bartlett Hayward Co., of Baltimore, Maryland, have issued a catalogue describing the Genter type oscillating continuous filter which consists essentially of individual tubular elements which are arranged in squirrel-cage fashion about a central shaft, this construction being open at one end. The cantilever element forming the bars of the squirrel-cage act not only as filter elements, but also as oscillating agitating arms as they work their way through the sludge bath contained in a tank in which the lower elements are submerged. A simple gear-driven mechanism oscillates the central shaft and elements in a continuously progressive manner around a complete circle, the speed of oscillation and advance being made to suit the conditions. The tubular elements are firmly clamped at one end to a spider containing the filtrate conduits leading to a rotary valve mounted on one end of the central shaft, this latter automatically controlling the application and cessation of suction on the elements entering submergence. A double unit containing a dividing wall so that two products can be simultaneously filtered is illustrated in the accompanying photograph.

Visco Engineering Co., Ltd., of 162, Grosvenor Road, London, S.W. 1, issue a booklet describing their dust collecting equipment, suitable for a great number of industrial purposes, and particularly the Visco-Beth automatic collector by means of which dust is drawn by a suitable exhauster through a number of cloth tubes arranged in compartments, which retain the dust whilst clean air is despatched



DOUBLE UNIT GENTER TYPE FILTER.

to the atmosphere or directly to the building. The dust is periodically and automatically shaken off, and at the same time blown off, by a mechanical shaking gear and a separate positive supply of clean scavenging air. The equipment is suitable in all cases where fine grinding operations are being carried out.

Wm. Beardmore and Co., Ltd., of Parkhead, Glasgow, publish a fully-illustrated catalogue, covering some 60 pages, describing high-speed Diesel engines, which are in increasing demand for a variety of duties, including especially road and rail traction. It is of interest to recall also the application of engines of this description to aircraft and notably their employment in the ill-fated airship R 101. In the majority of its applications the high-speed Diesel is the only rival to the petrol or the steam engine, while there are cases when it is applicable as an alternative to the low-speed standard Diesel. Beardmore engines are made in multi-cylinder vertical units in horse-power ranging from 60 to 1,500 and are suitable for use as prime movers for pumps, air-compressors, mechanical excavators, tractors, and similar duties.

Bucyrus-Erie Balanced Hoist for Shovels.

AN IMPORTANT EXCAVATOR IMPROVEMENT

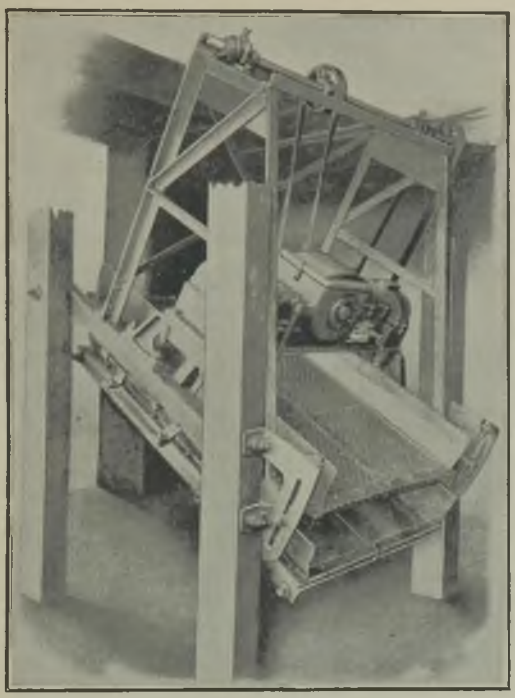
A definite advance in shovel design introduced in the United States during the past five years is the Bucyrus-Erie balanced hoist for stripping shovels, which is announced only after more than a year's experience in the field with several installations by the **Bucyrus-Erie Co.,** of Milwaukee, with which is associated **Ruston-Bucyrus, Ltd.,** of Lincoln.

This new hoist greatly increases the output of the stripping shovel by increasing the dipper size and by increasing the operating speed of the shovel. Its essential parts are a movable counterweight with the necessary guides and tackle, so arranged that as the dipper goes up through the bank in its digging motion, the movable counterweight travels downward in its guides, counterbalancing practically all of the weight of the dipper and increasing the amount of digging force available. As the dipper is returned to the pit for the beginning of its next cycle, the counterweight is raised in its guides so that it is again ready to counterbalance the dipper on its way up through the bank. Thus, during the hoisting cycle practically all the power of the hoist motors is spent in actual digging because the dipper's weight is counterbalanced in the manner described.

The counterbalanced hoist makes possible the use of much larger dippers without any increase in the size of electrical equipment and without any appreciable increase in the total weight of the machine beyond increased weight of the dipper and dipper contents. The balanced hoist requires no increase in the total amount of counterweight; a weight equal to the movable counterweight would be found on an ordinary stripper as stationary counterweight.

JAMES SCREENS

Holman Bros., Ltd., of Camborne, Cornwall, have published a catalogue fully descriptive of the James patent screens of which they are the sole manufacturers. These screens are of two types, known respectively as the Impact and Duplex Vibrating. The Impact screen receives 1,800 impacts per minute in a direction perpendicular to the plane of the screen surface whatever the angle of inclination thereof. The rocker derives its motion from a compound eccentric on the driving shaft of the vibrator, which throw may be adjusted to any value between the maximum and zero.



JAMES DUPLEX VIBRATING SCREEN.

The Impact machine is especially designed for screening fine material either wet or dry. For wet screening it is equipped with special wash-water trays and spray pipes and the screen surface is divided into three sections, such that a worn section may be easily replaced independently. The Duplex Vibrating screen is primarily designed for handling large quantities of relatively coarse materials either wet or dry. As there is not the same tendency for the screen to become " blinded," no impacts are produced by the mechanism, which is simply designed to produce uniform vibration perpendicular to the plane of the screen. They are generally made with two decks, each vibrating in approximately simple harmonic motion and having a phase relationship with respect to each other of 180°, that is, the two decks alternately move towards and away from each other with equal velocities and amplitudes. An example of the Duplex type of screen is illustrated here. In either case the vibrating mechanism may be belt or direct electrically driven.

METAL MARKETS

COPPER.—The copper market was fairly firmly maintained during December, thanks to a last-minute agreement between producers controlling 90% of the world's output, whereby they will curtail to 26⅔% of their capacity until certain conditions as regards prices and stocks are reached, but individual producers have the right to denounce the arrangement after twelve months. Drastic as the measures to be taken during 1932 are, it is doubted in some sections of the market whether they will be adequate to rehabilitate the market in the near future. World consumption still languishes, surplus stocks are high and trade prospects in America are slow to improve. In America electrolytic hardened from 6·75 to 7·25 cents per lb.

Average price of Standard Cash Copper: December, 1931, £38 6s. 5d.; November, 1931, £35 18s. 1d.; December, 1930, £46 16s. 4d.; November, 1930, £46 3s. 8d.

TIN.—The tendency of sterling tin prices in London last month was firm and a slight hardening in the American gold cent quotation would suggest that this was by no means altogether due to exchange weakness. Industrial conditions, apart from the South Welsh tinplate trade, are still generally unsatisfactory, but the market is rather hoping to see an improvement during 1932 in the statistical position of the metal thanks to the producers' curtailment measures.

Average price of Cash Standard Tin: December, 1931, £138 19s. 7d.; November, 1931, £132 18s. 10d.; December, 1930, £111 12s. 4d.; November, 1930, £113 11s. 10d.

LEAD.—This was a fairly good market during December, though doubtless prices were maintained partly on support by the associated producers. Industrial demand was quiet on the whole, though fresh arrivals, on the other hand, were not particularly heavy. It is believed that the output-control arrangements are working fairly satisfactorily, though the opening-up of the Mount Isa mine may present a minor problem. The market's prospects are regarded with moderate confidence in well-informed quarters. In America the quotation weakened during December from 3·85 to 3·75 cents per lb.

Average mean price of soft foreign lead:—December, 1931, £15 5s. 5d.; November, 1931, £14 10s. 8d.; December, 1930, £15 5s. 8d.; November, 1930, £15 18s. 7d.

SPELTER.—The London spelter market was moderately firm last month, and conditions in America were similarly favourable as the cent price moved up from 3·12½ to 3·15 per lb. Sentiment has been affected by the knowledge that the Cartel's stocks are being steadily reduced and that the additional 5% "cut" in output which took effect on December 1 is likely to improve the situation further. On the other hand, the long awaited revival in demand fails to make its appearance.

Average mean price of spelter: December, 1931, £14 11s. 9d.; November, 1931, £14 0s. 10d.; December, 1930, £13 19s. 9d.; November, 1930, £14 19s. 5d.

IRON AND STEEL.—The British pig-iron market remained cheerful during December and the position of the furnaces improved so that it is probable that the present restricted number of active units may be increased early in the New Year. Prices were steady, Cleveland No. 3 foundry remaining at 58s. 6d. minimum whilst East Coast mixed Numbers of hematite were dealt in around 65s. Business in finished British iron and steel remained disappointing.

IRON ORE.—The market as a whole continues very quiet, business falling away to nothing over the end-of-the-year holidays. Prices are largely nominal with best Bilbao rubio about 16s. 6d. per ton c.i.f.

ANTIMONY.—At the close of December English regulus was priced at from about £40 to £42 10s. per ton, while Chinese ruled at around £28 5s. ex warehouse, for spot, and £27 10s. c.i.f. for

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. Cash.	Standard. 3 Months.	Electrolytic.	Best Selected.	Cash.	3 Months.		Soft Foreign.	English.	Cash.	Forward.	
Dec.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	s. d.
11	37 10 7½	38 3 1½	45 0 0	38 15 0	137 2 6	140 2 6	14 3 9	14 18 9	16 10 0	20 7/16	20 5/8	125 0
14	36 15 7½	37 6 10½	44 10 0	—	136 18 9	139 18 9	14 0 0	14 16 3	16 5 0	19 15/16	20	118 9
15	36 14 4½	37 6 10½	44 0 0	38 0 0	136 8 9	139 8 9	14 0 0	14 16 3	16 5 0	19 5/8	20 1/8	119 1
16	37 18 1½	38 9 4½	44 0 0	—	138 3 9	141 3 9	14 2 6	14 17 6	16 5 0	20 1/4	20 7/16	119 7
17	39 0 0	39 12 6	44 10 0	—	138 11 3	141 8 9	14 6 3	15 0 0	16 10 0	20 7/16	20 11/16	119 6
18	41 3 1½	41 16 3	48 10 0	42 7 6	139 0 0	142 2 6	14 8 9	15 0 0	16 10 0	20 3/8	20 7/16	122 2
21	40 3 9	40 16 3	48 0 0	—	141 1 3	144 1 3	14 15 0	15 6 3	16 15 0	20 7/16	20 5/8	122 1
22	40 10 0	41 3 9	48 0 0	41 15 0	141 18 9	144 18 9	14 13 9	15 7 6	16 15 0	20 5/16	20 1/2	121 10
23	38 12 6	39 6 3	47 0 0	—	141 13 9	144 16 3	14 11 3	15 5 0	16 15 0	19 15/16	20 1/8	120 7
24	39 3 9	39 17 6	47 10 0	—	141 17 6	144 17 6	14 11 3	15 5 0	16 15 0	20	20 3/16	120 2
28	39 5 0	39 18 1½	47 10 0	—	141 16 3	144 18 9	14 6 3	15 7 6	16 15 0	20	20 3/16	120 8
29	38 11 3	39 6 3	47 0 0	39 15 0	141 3 9	144 6 3	14 7 6	15 12 6	17 0 0	20	20 3/16	120 0
30	38 10 7½	39 4 4½	47 0 0	—	141 3 9	144 8 9	14 7 6	15 11 3	17 0 0	20	20 1/8	120 8
31	38 3 1½	38 14 4½	46 10 0	39 5 0	141 3 9	144 6 3	14 6 3	15 7 6	16 15 0	20 3/16	20 3/16	121 11
Jan.												
4	37 11 10½	38 1 10½	46 10 0	—	139 6 3	142 11 3	14 6 3	15 1 3	16 10 0	20 1/8	20 1/8	122 2
5	37 19 4½	38 8 1½	46 10 0	39 5 0	136 18 9	139 18 9	14 6 3	15 2 6	16 10 0	20 7/16	20 7/16	122 5
6	38 13 1½	39 0 7½	46 10 0	—	137 11 3	140 11 3	14 7 6	15 3 9	16 15 0	20 5/16	20 5/16	122 9
7	39 8 1½	39 15 7½	47 15 0	—	140 8 9	143 8 9	14 11 3	15 7 6	16 15 0	19 13/16	19 13/16	121 8
8	39 3 9	39 9 4½	48 0 0	40 15 0	141 3 9	144 6 3	14 12 6	15 6 3	16 15 0	19 13/16	19 13/16	120 4
11	41 3 9	41 6 3	48 10 0	—	142 13 9	145 16 3	14 13 9	15 11 3	17 0 0	20	20	121 11

afloat. Metal for shipment from China was quoted at £26 10s. c.i.f.

Arsenic.—Cornish white is very scarce and nominal at £23 10s. per ton f.o.r. mines, whilst Mexican is quoted only against definite enquiries owing to exchange difficulties.

Bismuth.—After being advanced to 6s. 10d. per lb. early in December, the official price was reduced to 6s. per lb. towards the end of the month owing to the limited demand.

Cadmium.—A quiet but steady business continues at about 2s. 5d. to 2s. 6d. per lb., according to quantity.

Cobalt Metal.—There is not much moving, but prices are fairly steady at 3·65 dollars per kilo, although this figure is subject to rebates for good contracts.

Cobalt Oxides.—Demand has been rather slow just recently, current prices being in the neighbourhood of 5s. 4d. to 5s. 5d. per lb. for black and 6s. 1d. to 6s. 2d. for grey.

Chromium Metal.—This market keeps steady at the unaltered price of 3s. per lb.

Tantalum.—Business is spasmodic, but prices are unchanged at £25 to £30 per lb.

Platinum.—Demand has remained at a very low ebb during the closing months of 1931, prices moving with the American quotation. Current values of refined metal are £11 to £11 6s. per oz., according to quantity.

Palladium.—Current prices are about £5 10s. to £6 per oz., but there is hardly anything moving.

Iridium.—Business is slow and difficult, prices being rather nominal at about £24 to £26 per oz. for sponge and powder.

Osmium.—About £20 10s. to £21 per oz. is named, but there is hardly anything moving.

Tellurium.—In the absence of business, quotations continue quite nominal.

Selenium.—Sellers are quoting only against specific enquiries.

Manganese Ore.—No improvement has been seen in this market during the past month, hardly any forward business for the coming year having been done. Prices are nominally unchanged at 10d. to 10½d. per unit c.i.f. for best Indian, and 9d. to 9½d. c.i.f. for good 48% Indian and washed Caucasian.

Aluminium.—Towards the end of the year demand died away to small proportions, but prices remained unchanged at £95 sterling, less 2% for the home trade and £85 (gold) for export.

Sulphate of Copper.—English material is priced at £19 5s. to £19 15s. per ton, less 5%.

Nickel.—Demand has been anything but brisk recently, and leading producers are only working at about half capacity. Prices now stand at £245 to £250 per ton.

Chrome Ore.—A moderate business is reported at the unaltered basic prices of 80s. per ton c.i.f. for good 48% Rhodesian, and 95s. to 100s. c.i.f. for 55 to 57% New Caledonian, these figures being subject to extras on exchange account.

Quicksilver.—There has been no improvement in demand, which remains at a low ebb, and prices recently have eased to about £18 17s. 6d. to £19 per bottle, net, for spot material.

Tungsten Ore.—Exceptionally quiet conditions have prevailed in this market in recent weeks and prices have had a somewhat easier tendency. Chinese ore for forward shipment is priced at about 14s. 6d. to 15s. per unit c.i.f., but these quotations can only be regarded as nominal in the absence of actual transactions.

Molybdenum Ore.—Leading consumers are covered under long-term contracts, but odd parcels change hands occasionally at about 37s. to 38s. per unit c.i.f. for 80 to 85% concentrates.

Graphite.—This remains a dull market, with prices inclined to be nominal at about £16 to £18 per ton c.i.f. for good 85 to 90% raw Madagascar flake, and £17 to £19 c.i.f. for 90% Ceylon lumps.

Silver.—In the early part of December the market here showed some strength, mainly on the weakness of sterling, spot bars rising from 19¼d. on December 1 to 20 1/16d. on December 8. With an improvement in the Manchurian situation prices fell back to 19⅞d. on December 15, subsequently the market being quietly steady. On December 31 spot bars closed at 20 3/16d.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
December, 1930	867,202	41,290	908,492
January, 1931	873,872	40,704	914,576
February	800,991	38,946	839,937
March	869,331	41,667	910,998
April	840,259	42,078	882,337
May	867,949	42,330	910,279
June	855,073	42,677	897,750
July	872,198	44,645	916,843
August	870,822	45,603	916,425
September	872,053	43,971	916,024
October	900,353	44,760	945,113
November	855,102	45,408	900,510
December	877,178	46,175	923,353

TRANSVAAL GOLD OUTPUTS.

	November.		December.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	97,000	£147,381	90,000	£146,189
City Deep	69,000	18,053	78,000	21,157
Cons. Main Reef	66,000	22,654	66,700	22,928
Crown Mines	261,000	81,586	271,000	84,029
D'rb'n Roodepoort Deep	48,200	15,267	48,200	16,057
East Geduld	45,000	£13,516	51,000	15,152
East Rand P.M.	156,000	40,920	158,000	41,397
Geduld	83,600	26,801	84,200	26,899
Geldenhuis Deep	73,000	16,751	73,800	17,299
Glynn's Lydenburg	6,400	2,822	6,300	2,641
Government G.M. Areas	194,000	£388,372	230,000	£401,540
Kleinfontein	50,900	9,888	52,000	10,550
Langlaagte Estate	75,000	£106,626	79,000	£111,295
Luipaard's Vlei	30,700	£7,755	31,500	£8,009
Meyer and Charlton	9,920	£12,612	16,200	£16,627
Modderfontein New	161,000	64,016	168,000	65,498
Modderfontein B	74,500	22,164	74,000	21,388
Modderfontein Deep	44,000	21,797	44,700	22,030
Modderfontein East	72,000	21,103	73,500	21,439
New State Areas	73,000	£160,947	78,000	£166,111
Nourse	69,000	20,674	68,500	20,611
Randfontein	240,000	£272,387	240,000	£282,411
Robinson Deep	96,000	27,744	96,300	28,374
Rose Deep	62,000	12,728	59,100	12,470
Simmer and Jack	75,200	20,999	78,600	21,083
Springs	70,000	£143,942	68,300	£145,255
Sub Nigel	36,000	130,518	36,700	31,544
Transvaal G.M. Estates	16,200	5,292	16,600	5,150
Van Ryn	46,000	£43,742	47,000	£44,411
Van Ryn Deep	62,000	£92,864	64,000	£94,180
West Rand Consolidated	91,500	£103,506	94,500	£105,311
West Springs	73,100	£73,636	74,500	£75,129
Witw'tersr'nd (Knights)	61,000	£52,428	63,000	£55,093
Witwatersrand Deep	36,500	11,632	39,700	11,570

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., 1930	2,653,250	28 5	19 8	8 9	1,160,430
October	2,741,080	28 5	19 7	8 10	1,212,822
November	2,628,800	28 4	19 7	8 9	1,145,097
December	2,661,200	28 6	19 9	8 9	1,160,548
January, 1931	2,721,316	28 3	19 8	8 7	1,171,456
February	2,481,600	28 6	20 1	8 5	1,045,980
March	2,718,400	28 2	19 9	8 5	1,151,017
April	2,592,800	28 7	20 1	8 6	1,105,711
May	2,751,400	27 10	19 6	8 4	1,149,105
June	2,698,100	28 0	19 7	8 5	1,140,399
July	2,771,400	27 10	19 6	8 4	1,155,466
August	2,799,800	27 10	19 5	8 5	1,159,382
September	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

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
December 31, 1930	203,473	13,763	4,607	221,843
January 31, 1931	209,442	13,865	4,325	227,632
February 28	209,777	13,740	4,333	227,850
March 31	207,239	13,436	4,106	224,781
April 30	206,770	13,242	4,030	224,042
May 31	207,109	13,305	3,689	224,103
June 30	207,209	13,286	3,345	223,840
July 31	208,155	13,512	1,817	223,484
August 31	209,409	13,563	1,705	224,677
September 30	209,424	13,276	1,626	224,326
October 31	208,987	13,061	1,517	223,565
November 30	209,270	12,882	1,429	223,581
December 31	211,552	12,260	1,402	225,214

PRODUCTION OF GOLD IN RHODESIA.

	1928	1929	1930	1931
	oz.	oz.	oz.	oz.
January	51,356	46,231	46,121	45,677
February	46,286	44,551	43,385	42,818
March	48,017	47,388	45,511	42,278
April	48,549	48,210	45,806	43,776
May	47,323	48,189	47,645	43,731
June	51,762	48,406	45,208	44,118
July	48,960	46,369	45,810	44,765
August	50,611	46,473	46,152	43,292
September	47,716	45,025	46,151	42,846
October	43,056	46,923	45,006	44,260
November	47,705	46,219	44,351	44,516
December	44,772	46,829	46,485	—

RHODESIAN GOLD OUTPUTS.

	November.		December.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	24,800	9,905	24,800	11,815
Globe and Phœnix	6,062	6,401	6,008	6,193
Lonely Reef	7,500	3,054	7,500	2,686
Luiri Gold	1,295	949	—	—
Rezende	6,400	2,629	6,400	3,602
Sherwood Star	4,600	£7,913	4,800	£9,034
Wanderer Consolidated	15,300	3,232	14,900	3,176

WEST AFRICAN GOLD OUTPUTS.

	November.		December.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	5,143	£9,716	5,820	£10,806
Ashanti Goldfields	12,735	14,613	13,020	14,615
Taquah and Abosso	9,870	£14,102	10,535	£14,287

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.
	Oz.	Oz.	Oz.
December, 1930	42,097	3,105	260
January, 1931	27,306	—	405
February	38,370	4,458*	458
March	34,946	4,482	898
April	38,891	3,250	732
May	38,255	4,196	784
June	47,507	3,194	893
July	38,785	3,641	1,220
August	52,501	3,020	610
September	38,173	—	638
October	52,741	—	1,031
November	53,869	—	—
December	—	—	—

* Jan. and Feb.

AUSTRALASIAN GOLD OUTPUTS.

	November.		December.	
	Tons.	Value £	Tons	Value £
Associated G.M. (W.A.)	4,891	5,660	5,068	5,973
Blackwater (N.Z.)	3,630	7,716	3,292	6,250
Boulder Persev'ce (W.A.)	7,246	17,757	7,079	17,087
Grt. Boulder Pro. (W.A.)	9,751	26,908	—	—
Lake View & Star (W.A.)	15,769	24,222	—	—
Sons of Gwalia (W.A.)	12,690	13,876	12,410	13,738
South Kalgurli (W.A.)	9,280	15,328	9,026	16,537
Waihi (N.Z.)	16,831§	5,590* / 37,799†	25,041	8,781* / 16,360†
Wiluna	26,065	30,635	—	—

* Oz. gold. † Oz. silver. § To Nov. 14.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	November.		December.	
	Tons Ore	Total Oz.	Tons Ore	Total Oz.
Balaghat	3,450	2,154	3,600	2,110
Champion Reef	8,200	5,400	8,400	5,401
Mysore	16,683	8,272	17,338	7,652
Nundydroog	12,045	7,213	12,045	7,371
Ooregum	12,618	5,525	12,511	5,494

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	November.		December.	
	Tons	Value £	Tons	Value £
Chosen Corp. (Korea)	10,070	14,571	10,040	16,822
Frontino Gold (Colbia)	3,600	16,379	3,810	17,514
Fresnillo	81,051	8,253*d*†	—	—
New Goldfields of Venezuela	6,848	2,215*	7,061	2,257*
Oriental Cons. (Korea)	16,746	91,736*d*	16,374	90,372*d*
Remance	2,313	2,687	—	—
St. John del Rey (Brazil)	—	33,700	—	29,000
Santa Gertrudis (Mexico)	26,455	44,153*d*	—	—
Viborita	—	—	—	—
West Mexican Mines	1,470	24,800*d*	—	—

d Dollars. * Oz. gold. † Loss

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

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

January, 1931	5,450	July, 1931	4,757
February	5,470	August	5,375
March	4,461	September	2,449
April	4,510	October	3,282
May	5,089	November	2,488
June	4,813	December	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	October.	November.	December.
Ayer Hitam	41½	—	113
Batu Caves	18	—	40
Changkat	25	—	45
Gopeng	42	23	60
Hongkong Tin	—	—	77½
Idris Hydraulic	18½	1½	41½
Ipoh	122½	51½	28½
Kampar Malaya	29	—	—
Kampong Lanjut	56	48	50
Kamunting	155½	128	99
Kent (F.M.S.)	14½	—	34
Kinta	16	13	22½
Kinta Kellas	23½	17½	23½
Kramat Tin	80	75	70
Kuala Kampar	40	40	28
Kundang	12	—	—
Lahat	10½	10½	13½
Lower Perak	88	92	119
Malaya Consolidated	—	—	—
Malayan Tin	85	86½	77½
Malim Nawar	28	26	22
Pahang	125	125	125
Penawat	—	—	—
Pengkalen	34	—	75
Petaling	45	106	68
Rahman	40½	40½	40
Rambutan	4	—	12
Rantau	34	3½	25
Rawang	40	45	40
Rawang Concessions	45	29	35
Renong	38½	31½	25½
Selayang	15½	—	—
Southern Malayan	84½	84½	137
Southern Perak	30½	30½	26½
Southern Tronoh	12	34	31
Sungei Besi	33	33	33
Sungei Kinta	31½	—	15½
Sungei Way	59½	20½	77½
Taiping	21	13	18½
Tanjong	9	—	13½
Teja Malaya	—	—	—
Tekka	31	9	30
Tekka-Taiping	35	—	45
Temengor	10	—	—
Temoh	—	—	—
Tronoh	60	57	25
Ulu Klang	16⅛	—	—

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	October.	November.	December.
Anglo-Nigerian	52	48½	69½
Associated Tin Mines	242	157	255
Baba River	4	4½	6
Batura Monguna	2½	3	3
Bisichi	43	30	30
Daffo	5	—	—
Ex-Lands	51	38	49
Filani	3	—	6
Jantar	15	12	12
Jos	11½	12	—
Juga Valley	10	8½	6
Kaduna Syndicate	23	25	30
Kaduna Prospectors	12	12	11
Kassa	12½	11½	15½
London Tin	160	120	160
Lower Bisichi	4½	4½	—
Naraguta Extended	—	—	—
Nigerian Consolidated	10	10	—
Offin River	1⅞	2⅞	2⅞
Ribon Valley	10	10	16½
Tin Fields	6½	5	5½
United Tin Areas	17	14½	25
Yarde Kerri	—	—	4

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	October.	November.	December.
Anglo-Burma (Burma)	42½	36½	—
Aramayo Mines (Bolivia)	189	161	127
Bangrin (Siam)	110¾	76½	—
Beralt	30*	30*	30*
Consolidated Tin Mines (Burma)	130	100	95
East Pool (Cornwall)	46	46	—
Fabulosa (Bolivia)	56	57½	40†
Kagera (Uganda)	18	20	—
Kamra	26½	—	—
Malaysiam Tin	8½	9	8½
Mawchi	—	209*	—
Patino	1,039	1,056	—
Pattani	84½	—	—
San Finx (Spain)	21½*	22½*	—
Siamese Tin (Siam)	203¾	119	46½
Tavoy Tin (Burma)	75	56	61
Tongkah Harbour (Siam)	38	25	48
Toyo (Japan)	61	73	73
Zaaiplaats	16½	—	—

* Tin and Wolfram. † Tons fine tin.

COPPER, LEAD, AND ZINC OUTPUTS.

		Nov.	Dec.
Broken Hill South	Tons lead conc.	4,814	4,584
	Tons zinc conc.	5,218	4,844
Burma Corporation	Tons refined lead	5,880	5,880
	Oz. refined silver	470,000	470,000
Electrolytic Zinc	Tons zinc	—	—
Indian Copper	Tons copper	350	214
Messina	Tons copper	728	804
Mount Isa	Tons lead bullion	—	—
Mount Lyell	Tons concentrates	3,459	3,069
North Broken Hill	Tons lead conc.	4,830	—
	Tons zinc conc.	4,590	—
Rhodesia Broken Hill	Tons V_2O_5	31½	30
	Tons V_2O_5 conc.	—	75
Roan Antelope	Tons concentrates	3,001	295
	Tons blister copper	3,182	4,164
San Francisco Mexico	Tons lead conc.	3,670	3,993
	Tons zinc conc.	—	—
Tetiuhe	Tons lead conc.	390	—
	Tons zinc conc.	1,117	—
Trepca	Tons lead conc.	3,319	4,584
	Tons zinc conc.	3,815	4,312
Zinc Corporation	Tons lead conc.	5,654	—
	Tons zinc conc.	4,475	—

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

		October.	November.
Iron Ore	Tons	134,788	138,971
Manganese Ore	Tons	3,815	4,514
Iron and Steel	Tons	275,695	379,363
Copper and Iron Pyrites	Tons	9,063	27,857
Copper Ore, Matte, and Prec.	Tons	2,831	3,904
Copper Metal	Tons	13,252	11,537
Tin Concentrate	Tons	4,285	3,878
Tin Metal	Tons	671	875
Lead Pig and Sheet	Tons	22,295	30,487
Zinc (Spelter)	Tons	9,466	10,203
Zinc Sheets, etc.	Tons	3,029	3,550
Aluminium	Tons	3,807	1,914
Mercury	Lb.	151,558	114,308
Zinc Oxide	Tons	1,054	950
White Lead	Cwt.	18,443	22,124
Red and Orange Lead	Cwt.	5,242	7,243
Barytes, ground	Cwt.	47,883	53,280
Asbestos	Tons	1,354	2,948
Boron Minerals	Tons	416	115
Borax	Cwt.	14,413	12,185
Basic Slag	Tons	9,211	5,357
Superphosphates	Tons	6,497	8,998
Phosphate of Lime	Tons	13,289	27,827
Mica	Tons	126	146
Sulphur	Tons	4,285	3,425
Nitrate of Soda	Cwt.	177,939	550,865
Potash Salts	Cwt.	970,130	268,411
Petroleum: Crude	Gallons	24,518,771	12,739,899
Lamp Oil	Gallons	22,554,601	20,921,647
Motor Spirit	Gallons	84,517,218	61,563,771
Lubricating Oil	Gallons	12,290,692	7,242,942
Gas Oil	Gallons	11,089,930	3,929,802
Fuel Oil	Gallons	42,692,763	42,538,270
Asphalt and Bitumen	Tons	13,862	7,793
Paraffin Wax	Cwt.	119,922	150,162
Turpentine	Cwt.	29,884	32,870

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES.

In Tons.

	October.	November.	December.
Anglo-Ecuadorian	19,521	15,499	18,014
Apex Trinidad	46,100	40,600	43,380
Attock	1,659	1,832	1,809
British Burmah	4,443	4,224	4,350
British Controlled	41,636	37,022	39,738
Kern Mex	981	920	934
Kern River (Cal.)	3,138	2,922	2,554
Kern Romana	979	807	670
Kern Trinidad	4,684	5,523	4,792
Lobitos	26,141	25,420	25,746
Phœnix	44,532	38,594	45,707
St. Helen's Petroleum	5,592	5,147	5,053
Steaua Romana	87,120	82,267	—
Tampico	1,471	2,549	2,563
Tocuyo	1,911	1,619	1,730
Trinidad Leaseholds	16,550	13,050	13,650

QUOTATIONS OF OIL COMPANIES' SHARES.

Denomination of Shares £1 unless otherwise noted

	Dec. 10, 1931.			Jan. 11, 1932.		
	£	s.	d	£	s.	d.
Anglo-Ecuadorian		6	0		5	6
Anglo-Egyptian B.	1	2	6	1	0	0
Anglo-Persian 1st Pref.	1	2	9	1	3	0
,, ,, Ord.	1	10	6	1	11	9
Apex Trinidad (5s.)		9	6		10	3
Attock		15	6		13	9
British Burmah (8s.)		4	6		3	6
British Controlled ($5)		1	3		1	3
Burmah Oil	1	14	3	1	15	0
Kern River Cal. (10s.)		1	9		1	9
Lobitos, Peru		18	0		17	6
Mexican Eagle, Ord. (4 pesos)		6	0		6	3
,, ,, 8% Pref. (4 pesos)		6	6		6	6
Phœnix, Roumanian		3	6		3	9
Royal Dutch (100 fl.)	13	10	0	13	10	0
Shell Transport, Ord.	1	14	3	1	16	3
,, ,, 5% Pref. (£10)	8	15	0	8	15	0
Steaua Romana		4	3		3	9
Trinidad Leaseholds	1	0	0	1	4	6
United British of Trinidad (6s. 8d.)		2	6		3	0
V.O.C. Holding		16	3		17	6

PRICES OF CHEMICALS. January 11.

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.		19	9
,, 80%	,,	1	17	3
,, Glacial	per ton	59	0	0
Alum	,,	8	7	6
Aluminium Sulphate, 17 to 18%	,,	6	15	0
Ammonium, Anhydrous	per lb.		1	0
,, 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	15	0
Antimony Tartar Emetic, 43/44%	per lb.			10
,, Sulphide, golden	,,			9
Arsenic, White (foreign)	per ton	24	10	0
Barium, Carbonate, 94%	,,	4	10	0
,, Chloride	,,	11	0	0
,, Sulphate, 94%	,,	7	15	0
Benzol, standard motor	per gal.		1	3½
Bleaching Powder, 35% Cl.	per ton	8	15	0
Borax	,,	16	10	0
Boric Acid	,,	26	10	0
Calcium Chloride, solid, 70/75%	,,	5	5	0
Carbolic Acid, crude 60's	per gal.		1	9
,, ,, crystallized, 40°	per lb.			5¾
Carbon Disulphide	per ton	30	0	0
Citric Acid	per lb.		1	2
Copper Sulphate	per ton	18	0	0
Creosote Oil (f.o.b. in Bulk)	per gal.			5½
Cresylic Acid, 98-100%	,,		1	7
Hydrofluoric Acid, 59/60%	per lb.			6
Iodine	per lb.	1	7	9
Iron, Nitrate 80° Tw.	per ton	6	10	0
,, Sulphate	,,	2	4	0
Lead, Acetate, white	,,	44	0	0
,, Nitrate (ton lots)	,,	28	10	0
,, Oxide, Litharge	,,	31	0	0
,, White	,,	40	10	0
Lime, Acetate, brown	,,	8	0	0
,, ,, grey, 80%	,,	12	0	0
Magnesite, Calcined	,,	8	5	0
Magnesium Chloride	,,	5	10	0
,, Sulphate, comml.	,,	3	15	0
Methylated Spirit Industrial 61 O.P.	per gal.		2	0
Nitric Acid, 80° Tw.	per ton	23	0	0
Oxalic Acid	per cwt.	2	10	0
Phosphoric Acid. (Conc. 1·750)	per lb.			10
Pine Oil	per cwt.	2	5	0
Potassium Bichromate	per lb.			5
,, Carbonate, 96/98%	per ton	32	0	0
,, Chlorate	,,	34	0	0
,, Chloride 80%	,,	11	5	0
,, Ethyl Xanthate	per 100 kilos	7	0	0
,, Hydrate (Caustic) 88/90%	per ton	37	10	0
,, Nitrate	,,	25	10	0
,, Permanganate	per lb.			6½
,, Prussiate, Yellow	,,			8½
,, ,, Red	,,		1	8
,, Sulphate, 90%	per ton	12	10	0
Sodium Acetate	,,	21	0	0
,, Arsenate, 45%	,,	20	10	0
,, Bicarbonate	,,	10	10	0
,, Bichromate	per lb.			4
,, Carbonate (Soda Ash) 58%	per ton	6	0	0
,, ,, (Crystals)	,,	5	5	0
,, Chlorate	,,	29	0	0
,, Cyanide 100% NaCN basis	per lb			8
,, Ethyl Xanthate	per 100 kilos	6	10	0
,, Hydrate, 76%	per ton	14	10	0
,, Hyposulphite, comml.	,,	9	2	6
,, Nitrate (ordinary)	,,	8	14	0
,, Phosphate, comml.	,,	13	0	0
,, Prussiate	per lb.			5½
,, 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	5	0
,, Sulphite, pure	per cwt.		14	0
Sulphur, Flowers	per ton	12	0	0
,, Roll	,,	12	10	0
Sulphuric Acid, 168° Tw.	,,	4	5	0
,, ,, free from Arsenic, 140° Tw.	,,	2	10	0
Superphosphate of Lime (S.P.A. 16%)	,,	3	9	0
Tartaric Acid	per lb.		1	2
Turpentine	per ton	55	0	0
Tin Crystals	per lb.			10½
Titanous Chloride	,,			10½
Zinc Chloride	per ton	9	10	0
Zinc Dust, 90/92%	,,	20	0	0
Zinc Oxide (White Seal)	,,	35	0	0
Zinc Sulphate	,,	8	10	0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

GOLD AND SILVER:	Dec. 10, 1931. £ s. d.	Jan. 11, 1932. £ s. d.
SOUTH AFRICA:		
Brakpan	3 8 9	3 6 6
City Deep	5 6	5 6
Consolidated Main Reef	1 4 9	1 4 0
Crown Mines (10s.)	5 8 9	5 2 6
Daggafontein	2 17 0	2 17 6
Durban Roodepoort Deep (10s.)	19 0	19 0
East Geduld	3 8 0	3 5 6
East Rand Proprietary (10s.)	14 6	14 3
Geduld	4 14 6	4 10 0
Geldhenhuis Deep	12 6	11 3
Glynn's Lydenburg	5 0	5 0
Government Gold Mining Areas (5s.)	1 16 3	1 13 0
Grootvlei	1 8 9	1 6 3
Langlaagte Estate	1 7 6	1 6 0
Meyer & Charlton	1 2 0	1 2 0
Modderfontein New (10s.)	2 18 9	2 10 0
Modderfontein B (5s.)	13 3	12 6
Modderfontein Deep (5s.)	1 2 3	1 0 0
Modderfontein East	1 12 6	1 15 0
New State Areas	2 15 6	2 11 6
Nourse	18 0	17 3
Randfontein	1 7 9	1 8 0
Robinson Deep A (1s.)	16 3	15 0
,, ,, B (7s. 6d.)	11 3	10 3
Rose Deep	2 0	6 6
Simmer & Jack (2s. 6d.)	4 3	4 0
Springs	3 18 0	3 12 0
Sub Nigel (10s.)	3 17 6	3 14 6
Van Ryn	12 0	11 0
Van Ryn Deep	1 4 3	1 2 6
Village Deep (9s. 6d.)	2 6	2 6
West Rand Consolidated (10s.)	11 9	11 6
West Springs	15 0	13 9
Witwatersrand (Knight's)	11 6	10 6
Witwatersrand Deep	4 6	4 3
RHODESIA:		
Cam and Motor	1 8 9	1 7 6
Gaika	3 6	3 6
Globe and Phœnix (5s.)	14 3	14 9
Lonely Reef	16 3	16 3
Mayfair	4 6	4 6
Rezende	1 2 6	1 1 0
Shamva	1 0	1 0
Sherwood Starr (5s.)	12 0	12 6
GOLD COAST:		
Ashanti (4s.)	2 0 6	2 1 6
Taquah and Abosso (5s.)	6 0	6 0
AUSTRALASIA:		
Golden Horseshoe (4s.) W.A.	2 9	3 0
Great Boulder Propriet'y (2s.), W.A.	1 9	2 0
Lake View and Star (4s.), W.A.	8 3	8 3
Sons of Gwalia, W.A.	5 0	4 6
South Kalgurli (10s.), W.A.	12 9	12 0
Waihi (5s.), N.Z.	14 9	14 0
Wiluna Gold, W.A.	9 0	8 0
INDIA:		
Balaghat (10s.)	1 6	1 6
Champion Reef (10s.)	9 3	9 3
Mysore (10s.)	7 9	7 0
Nundydroog (10s.)	17 6	17 0
Ooregum (10s.)	3 9	3 9
AMERICA:		
Camp Bird (2s.), Colorado	6	3
Exploration (10s.)	2 6	2 3
Frontino and Bolivia, Colombia	16 3	16 3
Mexican Corporation, Mexico (10s.)	3 9	3 6
Mexico Mines of El Oro, Mexico	1 6	1 6
Panama Corporation	8 3	10 0
St. John del Rey, Brazil	18 9	18 6
Santa Gertrudis, Mexico	6 9	6 9
Selukwe (2s. 6d.), British Columbia	2 0	2 0
MISCELLANEOUS:		
Chosen, Korea	6 3	5 0
Lena Goldfields, Russia	6	6

COPPER:		
Bwana M'Kubwa (5s.) Rhodesia	3 6	3 0
Esperanza Copper	13 9	13 9
Indian (2s.)	1 0	1 0
Loangwa (5s.), Rhodesia	1 9	1 9
Luiri (5s.), Rhodesia	4 0	4 0
Messina (5s.), Transvaal	5 6	6 6
Mount Lyell, Tasmania	17 6	18 0
Namaqua (£2), Cape Province	3 9	4 0
Rhodesia-Katanga	11 3	11 3
Rio Tinto (£5), Spain	15 10 0	13 5 0
Roan Antelope (5s.), Rhodesia	9 3	8 3
Tanganyika Con.	15 6	17 6
Tharsis (£2), Spain	7 6	2 10 0

LEAD-ZINC:	Dec. 10, 1931. £ s. d.	Jan. 11, 1932. £ s. d.
Amalgamated Zinc (8s.), N.S.W.	6 3	6 3
Broken Hill Proprietary, N.S.W.	13 0	13 3
Broken Hill, North, N.S.W.	2 10 0	2 11 3
Broken Hill South, N.S.W.	1 13 9	1 16 3
Burma Corporation (10 rupees)	8 3	8 6
Electrolytic Zinc Pref., Tasmania	17 6	17 6
Mount Isa, Queensland	11 6	10 0
Rhodesia Broken Hill (5s.)	1 3	1 0
San Francisco (10s.), Mexico	9 6	8 0
Sulphide Corporation (15s.), N.S.W.	8 6	9 0
ditto, Pref.	10 6	10 6
Zinc Corporation (10s.), N.S.W.	1 3 9	1 3 9
ditto, Pref.	2 17 6	2 16 3

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

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

FINANCE, ETC.:		
Anglo-American Corporation (10s.)	8 6	7 6
Anglo-French Exploration	10 0	10 0
Anglo-Continental (10s.)	2 9	2 9
Anglo-Oriental (Ord., 5s.)	6 0	6 6
ditto, Pref.	8 6	8 6
British South Africa (15s.)	16 6	18 3
Central Mining (£8)	5 15 0	5 15 0
Consolidated Gold Fields	15 0	15 0
Consolidated Mines Selection (10s.)	6 3	5 3
Fanti Consols (8s.)	5 3	5 0
General Mining and Finance	15 6	15 0
Gold Fields Rhodesian (10s.)	3 0	3 0
Johannesburg Consolidated	1 2 3	1 1 0
London Tin Corporation (10s.)	10 0	10 0
Minerals Separation	2 0 0	2 5 0
National Mining (8s.)	3	3
Rand Mines (5s.)	2 19 6	2 18 0
Rand Selection (5s.)	7 9	7 9
Rhodesian Anglo-American (10s.)	7 3	7 0
Rhokana Corp.	3 15 0	3 5 0
Rhodesian Selection Trust (5s.)	7 0	6 6
South Rhodesia Base Metals	2 0	2 0
Tigon (5s.)	3 0	3 6
Union Corporation (12s. 6d.)	2 13 9	2 9 6
Venture Trust (10s.)	4 0	3 6

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

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

MINE VENTILATION WITH PROPELLER FANS

A paper presented before the South African Institution of Engineers by F. A. Steart and R. Henderson, and which appears in the *Journal* of the Society for November, 1931, deals with experiments on the application of airscrew propeller fans to mine ventilation. The subject is one of importance, and readers will recall an article by H. G. Smith, which appeared in the MAGAZINE for April last, and which dealt in part with this type of fan. Full extracts from Messrs. Steart and Henderson's paper are given here.

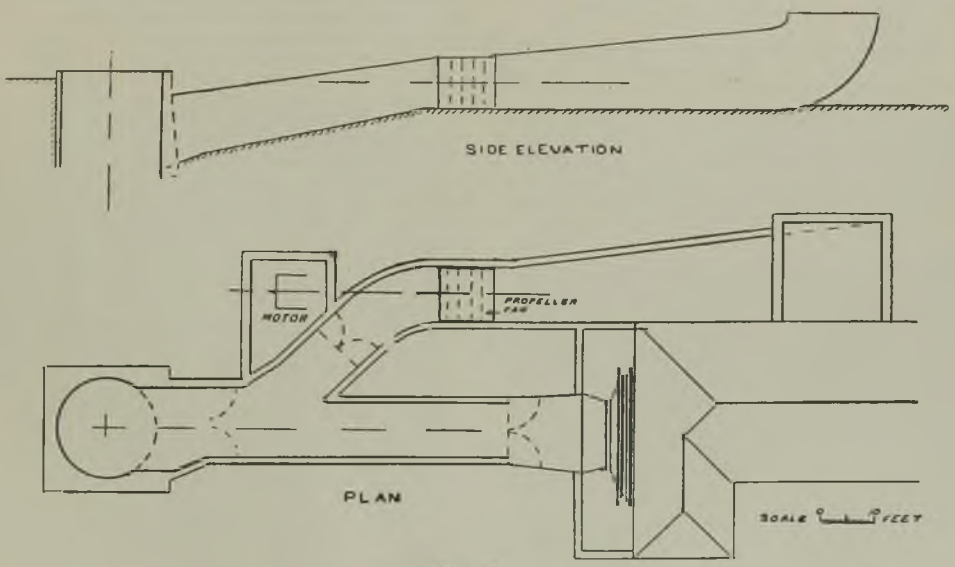


FIG. 1.

The authors state that they believe that the first serious attempts to apply the principle of the modern airscrew propeller to the ventilation of mines was made at the Northfield Colliery, Natal, when, in 1921, a series of experiments was commenced with aeroplane propellers. The results of some of these early attempts were published in two papers, entitled the "Application of Airscrews to Mine Ventilation," one of which was read before the Chemical, Metallurgical and Mining Society of South Africa in 1923, and the other before the North of England Institute of Mining Engineers in 1924. Until this time the view was universally held that fans of the propeller type could not operate with success, except when dealing with very low pressures, and were therefore quite unsuitable for the ventilation of mines. The experiments carried out at Northfield Colliery showed, however, that propeller fans, built up of airscrew propellers, were capable of setting up pressures, volumes, and efficiencies equal to those obtained by the average fan of the centrifugal type, provided the dimensions of the fans were suitable for the resistance against which they were required to work. During the tests which were carried out, mechanical efficiencies greater than 70% were obtained. The experiments showed generally, that in order to obtain the best results, it was necessary that there should be correct relationship between the dimensions of the fan—that is to say the diameter, pitch of propellers, number of stages—and the resistance or equivalent orifice of the mine.

The object of the present paper is to describe briefly some of the results of more recent work in endeavouring to obtain more information in regard to these relationships. Early in the experiments it was shown that where the resistance of a mine was small, best results were obtained from a fan of large diameter, propellers of high pitch and few stages, sometimes one only being sufficient to produce high efficiency. Where, however, the mine resistance was high, best results were obtained from fans of smaller diameter, propellers of smaller pitch, and more than one stage, whilst to obtain

large volumes it was necessary to run the fan at a higher speed.

The fan with which all the earlier experiments were carried out was 8 ft. 4 in. in diameter, the pitch of blades being 5 ft. 4 in. These were "Curtis" wooden, two-bladed, aircraft propellers, and were belt driven at a speed of 770 r.p.m. The belt was 8 ply, 10 in. in width, for which an allowance of 3% only was allowed in calculating efficiencies. When running six stages it was found that the best efficiency was obtained on an equivalent orifice of about 34 sq. ft. If the number of stages was reduced the best efficiency occurred on a larger equivalent orifice and if the stages were increased the peak of efficiency occurred on a smaller orifice. It was evident that the number of propellers which gave the best results when working at a certain equivalent orifice was unsuitable if the resistance was altered greatly. As it was not possible to obtain aircraft propellers of sufficient differences

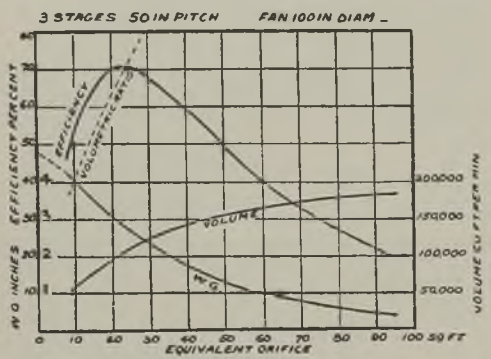


FIG. 2.

in pitch for testing, it was decided to make metal blades, for experimental purposes only, in the colliery workshops. These were designed in the first place with a pitch of 50 in., though, by turning and locking them in the hubs approximate pitches could be set up to 90 in. The hubs were made to carry four blades each, and sufficient blades and hubs were made for three stages.

A sketch plan of the present general arrangement of the fan is shown in Fig. 1. It will be seen that the propeller fan drift branches out of the centrifugal fan drift. Doors are provided in each in order to enable either fan to be used to ventilate the mine. Whilst the propeller fan was under test, doors were also provided near to the shaft entrance which could be operated so as to increase the resistance above that presented by the mine. The outlet of the propeller fan is continued horizontally as an évasée, the end being turned up, as shown, merely to prevent prevailing winds from blowing in.

The running of any required test was usually commenced with the shaft doors fully opened. A series of tests were then run with these doors closed a little more on each occasion until they were finally closed. When resistances less than that offered by the mine were required, the shaft top doors were opened. By regulating the resistance in this manner it was possible to ascertain the performance of the fan under these different conditions.

To give a brief example of one of these earlier tests with adjustable pitch blades: The diagram, Fig. 2, shows that with three stages set at an approximate pitch of 50 in. (the diameter of the fan being 100 in.) the efficiency curve rose to approximately 70% on an equivalent orifice of approximately 20 sq. ft. When, however, the pitch was set to 60 and 70 in. respectively, the peak of the efficiency curve occurred further to the right in each case, the equivalent orifices represented being now approximately 24 and 28 sq. ft. respectively. Judging by the experiments, it seems that, other things being equal, the equivalent orifice at which the fan shows its best efficiency varies directly as the pitch; for instance, if a propeller or series of propellers of, say, 50 in. pitch gives maximum efficiency at an equivalent orifice of, say, 20 sq. ft. when the pitch is increased to 60, 70, or 80 in. respectively, maximum efficiencies will occur at equivalent orifices of 24, 28, and 32 sq. ft. approximately.

Over two hundred separate tests were run, in all of which the fan was exhausting from the mine. The authors were, unfortunately, unable to carry the tests beyond three stages as the power available for this work was insufficient. Indications pointed, however, to an improvement in the results obtained had they been able so to do. It was thought desirable to carry out some further investigations on similar lines with a fan of smaller diameter. With this in view, advantage was taken of a steel smoke stack 5 ft. in diameter and 75 ft. in length, which lay in the colliery yard. Arrangements were accordingly made to fit into one end of this tube a fan which could have from one to four stages, each stage being fitted with four adjustable blades. These blades were of steel and carefully designed of helical form and made to a pitch of 30 in. The face or delivery side of the blades was made scoop shaped with rounded back, as shown in the drawing, Fig. 3, which also shows the method of attachment to the hub. By adjustment in the hub, pitches could be approximately set from 30 to 60 in. At the exhaust end of the tube provision was made for an évasée outlet, which was carefully designed, the angles of the sides and top diverging at an angle of $3\frac{1}{2}°$ to the centre line, i.e. 7° contained angle, which was found to give the best results. This évasée was laid out horizontally and at an angle from the gallery in order to accommodate the shaft and motor. The area of the outlet end was approximately four times the area of the fan. The fan was always used exhausting. At the intake end a shutter was fitted which could be operated by a lever to increase the resistance as and when required. The fan was directly connected to a 40 h.p., three-phase motor, the speed of which was 960 r.p.m.

Measuring Instruments.—At the motor end the power absorbed by the fan was indicated by means of a certified watt-meter, the horse power at the fan shaft being determined from this instrument in combination with the efficiency curve of the motor also certified by the makers. The general layout of the plant is illustrated in the photograph, Fig. 4. Much care was taken to ascertain the air velocities and total pressures. The instrument used for this purpose being the "Prandtl Tube," which is an improvement on the "Pitot Tube." The instrument has been more recently described in detail by Mr. Flugge-de Smidt[1] in his paper "Measurements of Static Velocity and Total

[1] *Journal* of the Underground Officials' Association of South Africa, July, 1929.

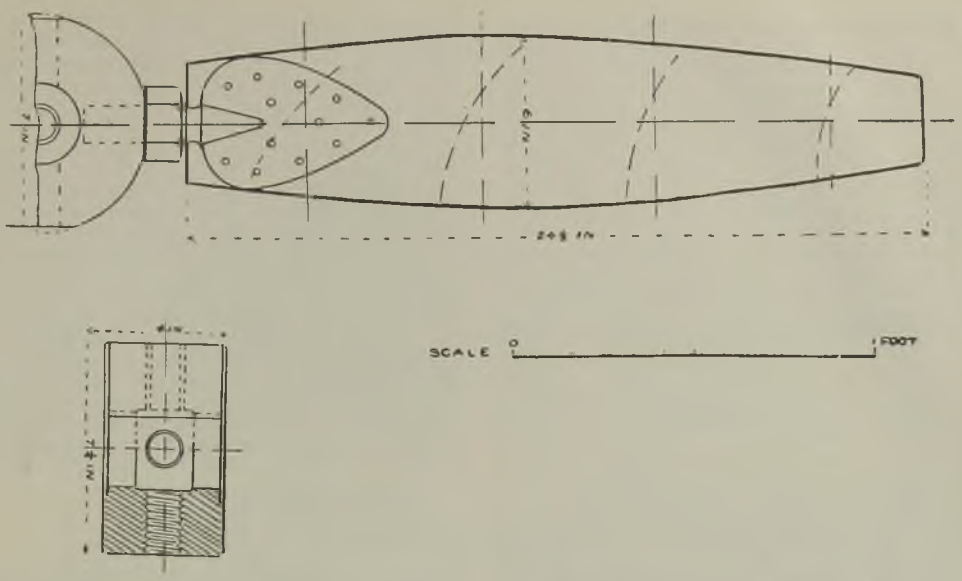


FIG. 3.

Pressures." The tube was set to face the incoming current, and to insure that the air-flow was direct and unaffected by the rotation of the fan, two thin plates were set at right angles across the diameter of the airway in front of the fan and extending beyond the tube. In order to ascertain correctly the average velocity of the air current, this "Prandtl Tube" was made of ample length so that it could be conveniently passed from side to side across the diameter of the airway. The instrument was supported on a flat board made for this purpose placed at the correct height above the ground. By sliding the instrument forward on this table, velocity readings were taken at intervals of 3 in. across the diameter during the running of the fan. These readings were repeated many times, and from them a point in the tube was ascertained which always gave the average velocity in the airway. This point was approximately 8 in. from the side. The Prandtl Tube was then fixed in this position during the experiments. The actual measurements of velocities were read off on an inclined gauge which had been carefully designed and set on a level concrete slab. The liquid used in this instrument was paraffin. It was found that more accurate readings could be made by this means than with water, as it worked more steadily and smoothly. Due allowance was, of course, made for the use of this liquid, and the gauge carefully and frequently calibrated against water to avoid error. With this gauge connected to the two limbs of the Prandtl Tube, velocity pressures could be easily read to three decimal places. Total pressures were recorded on the usual vertical form of water gauge. Temperatures of the air inside the airway were frequently taken during the course of the tests by means of the thermometer. Barometer readings were also carefully observed before running each test. Determinations of the velocity of the air passing were made in accordance with the formula

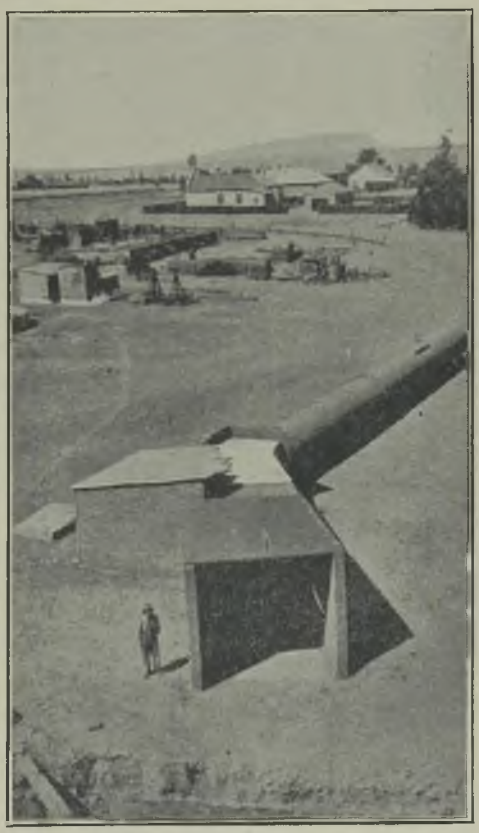


FIG. 4.

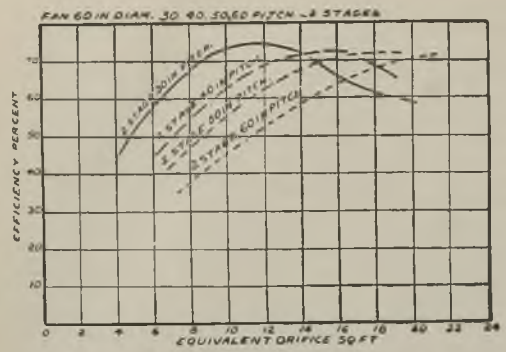


Fig. 5.

$$V = 1096{\cdot}2\sqrt{\frac{VP}{w}}$$

where
V = velocity of the air in ft. per min.
VP = velocity pressure in inches of water.
w = weight in lb. per cu. ft. of air in the airway.

Not less than two hundred tests were run with the plant described, and with the fan set to different combinations of pitch of propellers and number of stages, as opportunity offered, between October, 1929, and March, 1930, which involved a large amount of calculation in order to complete the necessary test sheet records (Table I and Figs. 5 and 6).

The method of procedure in running through a test was briefly as follows:—The particular combination of pitch and stages having been determined, the fan was run with the shutter at the intake end full open for a while, during which time the water gauge, velocity gauge, power, temperature and barometer were carefully observed and noted on the test sheet. Further resistance was then set up by restricting the intake with the shutter, after which another complete set of readings was taken and recorded. This process was repeated, the resistance being increased on each occasion, until the shutter was closed. The average number of separate runs during a complete test of a particular combination was about twelve. With the information available from the observations, determinations of velocity, volume, pressure, powers, equivalent orifice, mechanical efficiencies, volumetric ratios, etc., were all made and entered in the completed test sheets. From these, diagrams were made as soon as possible, and if any of these showed serious inconsistency in any particular, the tests were run over again in order to see if any error in observations or recording had occurred.

In none of the tests made was it found that the highest mechanical efficiencies coincided with the highest volumetric ratios. The best mechanical efficiencies occurred in all cases when the volumetric ratio was from 65 to 75%, or, in other words, when the air slip was from 25 to 35%. The results of the testing of the smaller fan confirm generally the observations which had been made when experimenting with the larger. The smaller fan showed the same general characteristics, and again showed that good efficiencies could be obtained with this type. It was found that no improvement in efficiency was obtained by increasing the number of stages beyond three or four in the small fan.

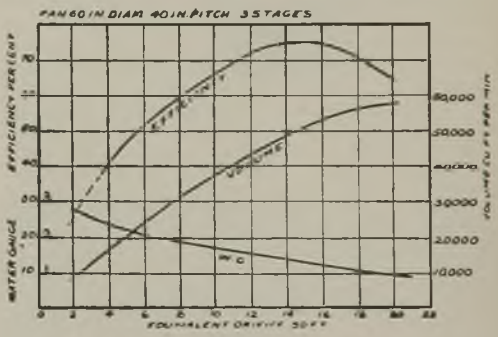


Fig. 6.

The area of the blades in this case is, however, much larger in proportion to the area of the fan than was the case with the larger fan, and possibly accounts for this. The experiments showed that by varying the combinations of pitch and number of propellers in the same fan, mechanical efficiencies of not less than 70% could be obtained over equivalent orifices varying from 20 sq. ft. (or rather more than equal to the area of the fan) to equivalent

Table I.—Test of Air-Screw Fan, 5 Ft. Diameter.

No. of Stages, 2. No. of Blades per stage, 4. Pitch of Propellers, 60 inches. Speed, 960 r.p.m.

Date of Test, 3rd August, 1929.

Barometer, 25·22 in. Thermometer, 70° F. Weight of cubic foot of air, ·0630 lbs.

Ref. No.	Velocity Pressure in inches of water.	Volume cu. ft. per Min.	Water Gauges In. Facing.	Input to Motor. Kilo-watts.	Horse Power. In Air.	Power. At Fan Shaft.	Mechanical Efficiency per cent. based on facing W.G.	Equi-valent orifice sq. ft.	Resis-tance in Atkin-son's.	Volu-metric ratio per cent. approx.	Remarks.
1	·83	77,800	·95	17·5	11·6	19·0	61	28·7	3·27	80	
2	·70	71,380	1·20	18·5	13·5	20·0	67·5	23·6	4·84	73·6	
3	·66	69,420	1·35	19·0	14·76	20·6	71·6	21·5	5·84	71·5	
4	·465	58,140	1·50	19·25	13·74	20·75	66·2	17·1	9·23	60·0	
5	·360	51,300	1·53	18·25	12·30	19·8	62·1	15·3	11·53	52·8	
6	·212	39,330	1·55	17·50	9·6	19·0	50·5	11·2	21·53	40·5	
7	·140	31,804	1·60	17·50	8·0	19·0	42·1	9·2	31·91	32·7	
8	·100	27,020	1·70	18·0	7·23	19·5	37·0	7·4	49·36	27·8	
9	·035	15,990	1·90	18·25	4·78	19·8	24·1	4·1	99·26	16·5	
10	—	—	2·35	19·50	—	21·2	—	—	—	—	Closed.

orifices as low as 8 sq. ft. or equal to less than half the area of the fan, whilst the range giving mechanical efficiencies above 60% is much greater. A somewhat similar range of flexibility was found with the larger fan, though the tests here were greatly hampered by lack of power, and, as before mentioned, we were unable to carry on the work beyond three stages. More recent work seems to point to the probability that the larger fans should be provided with propellers of considerably larger area, i.e. much greater width than those employed successfully in fans of smaller diameter.

Size of Fan.—In regard to the important question of size of fan for any particular duty, it would seem, judging by results obtained from our experiments, that fans of this type can be so adjusted in pitch and number of stages as to deal efficiently with equivalent orifices ranging in size from the area of the fan to half its area, and that in order to accomplish this the propellers should be capable of adjustment in approximate pitch from a maximum equal to the diameter of the fan to a minimum equal to the radius of the fan. It is realized, however, that there is still much to learn in regard to this type of ventilator. Further investigations are still being made as opportunity permits, and, no doubt, some improvements will be effected.

The main results of the investigations which have been made have proved that propeller fans of this type can be built to work efficiently on resistances commonly met with in mines, and that such fans possess considerable flexibility in that adjustments can be made from time to time to meet efficiently wide variations in resistance. That this fan has made considerable headway and gained in favour is shown, for whereas in 1924 there was only one of its kind in use, viz., at Northfield Colliery, there are to-day twenty-five of these fans working in South Africa dealing with not less than 3,000,000 cu. ft. of air per minute, in addition to several elsewhere. An example of test figures is given in Table I.

A NEW HOIST FOR THE LAKE SHORE MINE

A description of a large electric hoist by G. A. Young appears in the *Canadian Mining Journal* for December, 1931. The hoist is to be installed shortly at the property of the Lake Shore Mines, Ltd., at Kirkland Lake, Ont., and will be the first direct-connected, direct current operated hoist to be installed in the Kirkland Lake District, and some very interesting features have been incorporated in its design. It has the added distinction of being the first and largest hoist of its kind to be designed and built in Canada. It will be located on the surface and will be used for skip operation at the main shaft, hoisting ore from the 4,200 ft. level. The principal dimensions, speeds and capacities are as follows :

Diameter of each drum—10 ft.
Width of each drum—6 ft.
Capacity (Maximum pull on one rope)—45,000 lb.
Diameter of hoisting rope—1¼ in.
Maximum hoisting speed—2,000 ft. per min.
Drum speed—63 r.p.m.
Motor horse power—1,350.
Maximum accelerating peak h.p.—2,700.
Depth from which ore will be hoisted—4,200 ft.
The rope pull load is made up as follows :—

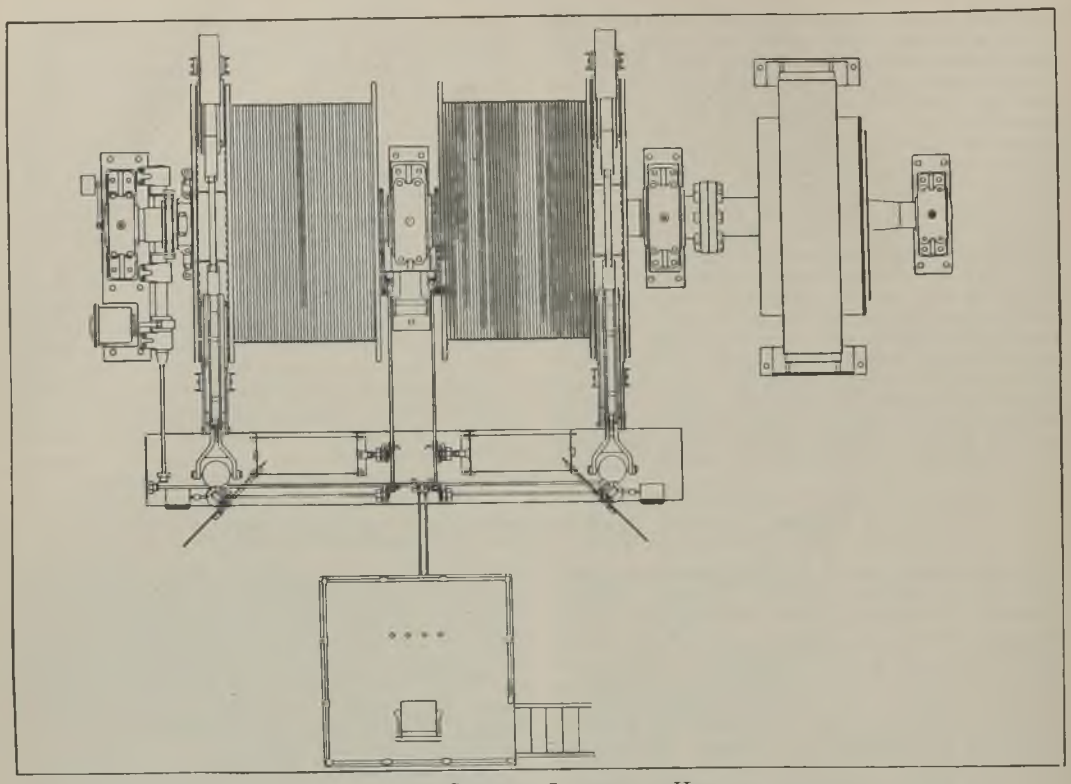
Weight of ore . . .	12,000 lb.
Weight of 4,200 ft. 1½" rope	17,640 lb.
Weight of skip . . .	10,000 lb.
Total load of one rope . .	39,640 lb.

The hoist is of the direct connected type, consisting of two drums in line on a drum shaft, with a direct current motor armature mounted on an extension of this same shaft. The shaft is made in two sections, connected by means of a flanged coupling, one half of which is forged integral with each section of the shaft. The drum shaft is of hollow construction, having a hole bored through its entire length. The motor armature is keyed to the shaft, as is also one of the hoist drums. The other drum is free to rotate on the shaft and is driven by a clutch of the positive type.

The drums are of very rigid construction, consisting of end flanges of cast steel, made with "H" shaped arms, resembling modern gear design. The flange extends to the drum periphery, and forms part of the drum barrel. The centre portion of the barrel is made from thick rolled steel plate, having cast steel reinforcing rings riveted inside. The two flanges and the barrel are fastened together by fitted bolts, thus giving that strong, rugged construction, which is so essential to successful mine-hoist operation. The drums are spirally grooved for the ropes. The weight of each drum is approximately 32 tons, and the total inertia of the moving parts amounts to 2,600,000 lb. ft.²

The drum-shaft is supported in four bearings of the spherical roller type. These bearings were supplied by the Canadian SKF Company Ltd., and are the largest capacity spherical roller bearings in Canada. The use of anti-friction bearings in this hoist establishes an interesting precedent in hoist design, and follows the general tendency of designers of railway equipment, electric motors, etc., to use this type of bearings on heavy equipment. The object of this unique development is to reduce the friction when starting from rest and during acceleration, which is considerable. The peak loads will be reduced in proportion, with consequent savings in power charges, which are governed to a large extent by peak load demands. The length of the entire machine is also reduced considerably, due to the spherical roller bearings being much shorter than the ring-oiling bearings generally used in a hoist of this size. This reduction in length of drum shaft also enables the shaft to be decreased in diameter slightly, owing to the unsupported length being decreased. Another valuable advantage which accrues from the use of spherical roller bearings is the decrease in the fleet angle of the rope which can be obtained. The spherical roller bearing between the drums being much shorter than the ring oiling type of bearing generally used, enables the drums to be located closer together. In most cases this would result in a reduced fleet angle with consequent improvement in rope winding and reduced rope wear.

The design of clutch used on this hoist is also very interesting. It is of the positive type ; but is designed in such a way as to eliminate many of the disadvantages usually found in positive clutches. The clutch is of the internal-expanding jaw type, and consists of an internal gear bolted



PLAN SHOWING LAYOUT OF HOIST.

to the drum flange, with a driving member keyed to the shaft. This driving member has two radial slots, in which jaws slide with teeth cut on their outer ends. These jaw teeth engage with the teeth in the external gear. An arrangement of toggles and links is provided to operate the jaws. The toggles and links are in turn actuated by a sliding sleeve and rock shaft, which receive their motion from a compressed air cylinder. This compressed air cylinder is under the control of a hand lever located on the operator's platform.

One of the chief advantages which this type of positive clutch has over the sliding gear type of positive clutch is the comparatively small distance which it is necessary to move the drum to engage the teeth. Another advantage of this type of clutch is that there is no driving member which must be moved endwise on the shaft, either fitted to a hexagon or on keys. Instead, the driving member has a hub clamped tightly on the shaft, and therefore gives a much more satisfactory drive. With the sliding gear type of clutch considerable end thrust exists while the two gear members are in contact with one another prior to the teeth engaging. Such end thrust is entirely eliminated in the clutch herein described.

A valuable feature of this type of clutch is the radial adjustment which it is possible to make. This adjustment ensures that the teeth can be engaged absolutely tight and eliminates all slack and lost motion.

The hoist is equipped with brake and clutch interlocks to prevent the possibility of the clutch being disengaged at any time except when the loose drum brake is set. There is also an interlock to prevent the clutch being engaged except where the brake of the keyed drum is almost completely set. In this way the possibility of the operator trying to engage the clutch when the hoist is running at high speed is eliminated.

The brakes are of the post type, centrally swung, and are operated by compressed air engines of the balanced air type. These air engines have air on both sides of the piston, giving that air-cushioned effect which renders unnecessary the use of oil dash pots and spring boxes to give smooth braking. The brake posts are of arc welded steel plate construction, and are lined with basswood blocks. An improved design of brake path is used having a brake tread made in twelve circumferential sections, so arranged that all expansion due to heating is taken up in the gaps between the sections. The brake path therefore remains a true circle of constant diameter under all conditions. Adequate ventilation of the brake tread is arranged and heat conduction to the drum flange reduced to a minimum. The design of brake path has many advantages over the standard type in that it ensures smoother braking, easier brake control, true brake paths under all conditions of braking, and therefore more satisfactory and safer hoist operation.

The hoist is very completely equipped with safety devices, including two "Lilly" hoist-controllers, which prevent overspeed, overwinds, and faulty retardation. Brake regulator valves are also furnished, which in conjunction with the Lilly controllers, prevent the brakes being applied rapidly on an emergency stop unless the skip is within a predetermined design of emergency brake setting distance from the end of its travel. A

simplified design of emergency brake-setting devices is incorporated, in which the number of parts employed is reduced to a minimum. The operation of resetting the safety devices after an emergency stop is accomplished by pushing the brake hand levers a short distance beyond their normal travel, thus eliminating the necessity of the operator leaving the platform or of having a special arrangement of resetting levers and mechanism. Travelling nut limit switches of the screw type are also employed in connection with the electrical control.

Depth indicators having 60 in. diameter dials are mounted in front, giving a clear view of the drums and the ropes. The indicators are driven by gears and shafts from the drum. An elevated operator's platform is provided on which are located the control levers and electrical switches.

The designs of clutch and brake path were developed by the makers of this hoist in conjunction with Mr. D. L. Cramp, Mechanical Superintendent of the Lake Shore Mines. Patent applications covering these designs have been made by Mr. Cramp, who is the inventor of both features.

The hoist is arranged for operation by a 1350 h.p. direct-current motor and the control equipment includes a Ward-Leonard Ilgner flywheel-set. The complete electrical equipment was supplied by the Canadian Westinghouse Company.

LEAD-ZINC DEPOSITS ON THE GOLD COAST

In the report of the Geological Survey Department of Gold Coast Colony for 1930–31 a preliminary account of the lead-zinc deposits of Ogoja Province is given by C. M. Tattam. Dr. Tattam says that the lead-zinc lodes of Ogoja Province have been known since the earliest times of the British occupation of the Cross River hinterland. The officers of the Mineral Survey of Southern Nigeria visited some of the more important of them, but although their reports were not unfavourable, no serious attempt at exploitation was made till about the year 1920. At the present time development is progressing on the Ameka and Nyeba areas south of Abakaliki, while prospecting licences are held on certain promising areas to the north-east of this station. All the known occurrences of appreciable size had, however, been worked at some earlier period. These workings were essentially of a surface nature, but penetrated in some cases to a depth of 30 ft., timber supports being used at those depths. The present natives are unable to throw much light upon the identity of the old miners, although at Ameka they have legends of white men once being there. It is certain that if the forbears of the present inhabitants were miners they failed to hand on their craft. Since there remains little trace of the products of the very considerable amount of ore that must have been won, it may be presumed that all was exported; hence it is possible the mines were controlled by a foreign people. So far as Ogoja Province is concerned all the important deposits at present known lie within Abakaliki Division. Small lodes occur in north-western Ogoja and one has been prospected in the Uburu district of Afikpo.

Physiography.—The field extends over a part of the Cross River plains. The drainage is generally from north-north-west to south-south-east, the principal rivers being, from west to east the Western Aboine, Eastern Aboine, and Ewayon, with its important tributary the Okporku. Relief is small throughout. The river systems are mature and the main divides are flat plains, carrying a thick mantle of ironstone or ferruginous soil and are frequently marshy. Such landmarks as exist are special features due to local resistance to erosion. They usually mark the sites of eruptive rocks or a certain type of barren lode. With the exception of the main lode at Ameka and possibly that at Nyeba the lead-zinc deposits have had not even a local effect upon topography.

General Geology.—All the country rocks of the lead-zinc field fall within the lower division of the Cretaceous shales, established by earlier work of the Geological Survey upon the sedimentary rocks of south-eastern Nigeria. Throughout the whole area shales, with subordinate beds of sandstone, predominate. In certain districts, however, the shale facies is modified by the intercalation of sandstone bands often several feet thick.

Along the lower reaches of the Western Aboine in Afikpo Division a very distinct shale-sandstone facies is encountered. The shales are darker in colour than the usual type and split into fine fragments on disintegration. The sandstones are as a rule coarse and of the nature of gritty quartzites. They resemble in some respects the sandstones of the Carbonaceous and pebbly sandstone group, but are generally harder. While these sandstones are distinct from those of the Ezza country there is yet a possibility that both belong to the same phase of sedimentation. Distributed throughout the field are dark blue-grey calcareous beds. They are composed of crushed shells cemented by a matrix ranging from comparatively pure calcite to sand and silt. The finer grained are fairly pure limestones; the coarser varieties are arenaceous and all gradations between the two occur so that classification is more or less arbitrary. A medium grey crystalline limestone occurs in various parts of the areas where the medium-grained sandstones outcrop. It is to be seen about 500 yards north of Okpoto Hill, about 1½ miles north-north-east of Mgbo Court, where the Effium track crosses one of the head waters of the Eastern Aboine, near Obomalagu north of Mgbo, and at Nwaobodo three miles west of Ijogo Market in northern Ishieke. It is doubtful whether these outcrops are of the same bed; if they are then the rock should form a useful stratigraphical horizon. A large mass of semi-crystalline, pale-grey limestone occurring at Nkalago has been examined only cursorily from an economic point of view. Its thickness would appear to be not less than 150 ft., so that if it is not lenticular it too should provide an important datum line. A marcasitic pisolite occurs close to Nzamgbo Rest House and in the neighbourhood of Odumoke.

Basic igneous rocks of varying textures occur as dykes or small stocks over a considerable part of the field, although more especially in the north and north-eastern areas. They tend to be restricted to definite strips of country running roughly north-east–south-west.

The mineral veins lie generally in the same belts of country as the igneous rocks. The strikes

of the individual lodes are, with certain exceptions, close to north-south. There appear to be two types, the one carrying either lead or zinc or both metals, the other, so far as can at present be seen, entirely barren. With the exception of a small occurrence south of Uburu in Afikpo Division, all the sulphide-bearing deposits so far known occur east of a north-south line lying a mile or two west of Abakaliki station. Nearly all the barren lodes on the other hand occur in the south-western part of Abakaliki Division and the neighbouring part of Afikpo. They are almost invariably the sites of small hills. In the environs of Abakaliki station both types occur. The chief gangue of the economical lodes is siderite while quartz is abundant in some cases. These two minerals probably compose the unweathered part of the barren lodes. The narrow lode close to the Lefun Ikerri Court in Ogoja Division has a calcite gangue. Thin veins of milky quartz occur throughout the whole field.

Structural Geology.—The structure of the Cretaceous Lower Shale Group is essentially a fold system which, over the greater part of the area involved, runs in a direction approximating 50°–230°. Pitching, both to north-east and south-west, occurs however, a feature indicated by the dipping of the strata in these directions along the fold axes. Owing to frequent minor contortions most apparent along the fold axes also, the exact configuration of the regional pitching is rendered difficult of determination. The strata dip normally to north-west or south-east in the order of 5° to 20°, but along certain zones the dips become steep, even to vertical. Such phenomena occur frequently along the fold axes but appear in the flanks as well.

Jointing is complex and variable within small compass. The usual tension joints more or less at right angles to the strike of the folds are universal, likewise diagonal pressure joints, though often only one set of the latter is distinct. Other systems are also generally present.

As was mentioned earlier the igneous rocks and mineralized areas tend to lie along definite north-east–south-west belts. The chief of these belts includes the "barren" lode area of Oshiri and Onicha, the small group of lodes at Ogbaka Hills in Ezza, Abakaliki itself with its two varieties of lodes and its igneous rocks, the lead-zinc lodes of Mkpuma, Akwatapka and Mkpuma Akwaokuku with the diorite of the latter, the Otam Mkpuma Akpuma stock and the igneous rocks and lead-zinc lodes of Ollua, Adum and perhaps Lefun Ikerri. In these last named north-easterly regions, however, igneous intrusion is widespread. Parallel with this belt lies another to the north-west. This includes the Okpoto-Mtezi area of "barren" lodes and the zone of igneous intrusion of Odumoke and Ndi Etiti and the lead of Ekwa Abaja. The Ameka-Nyeba lodes indicate a third belt which appears to be of small extent unless the "barren" lodes of the Ugulangu Hills can be regarded as lying within it. These belts are obviously related to the fold system but their exact structural significance is not yet clear. They are evidently zones of crustal weakness which, in the case of Ameka-Nyeba and central belts, are anticlinal. While the igneous stock of Ndi Etiti occupies a minor anticline, there is no evidence that the northern belt coincides with the axial regions of a major fold.

Igneous Rocks.—The number of outcrops of igneous rocks is considerable and macroscopic examination indicates that they are essentially basic, nothing more acid than normal diorite having so far been discovered. The majority of them contain specks of pyrite and would appear to be rather rich in magnetite or ilmenite. Typical medium-grained diorites are perhaps the most common. Fine-grained diorites are abundant and widely distributed. Still finer varieties, tentatively referred to as dolerites, are widely disposed throughout the field. Some striking porphyritic hornblende rocks occur in the Oza district. One in particular at Otam Esekwe exhibits black hornblende crystals approaching one inch in length set in a fine medium-grey ground mass. The elliptical mass of Ndi Etiti, some fifteen miles north of Abakaliki, displays a fine-grained component along its edge. The main core is composed of a peculiar patchy coarse-grained rock, a gabbro or an epidiorite. The chief constituents are augite, felspar aggregate, and a yellow-green mineral, presumably epidote. Sulphide specks are rare, but black iron ores prominent.

The three known masses in the environs of Abakaliki, are interesting and rather problematical. The larger masses have had a distinct though not severe metamorphic action upon the shales. The usual effect has been to slightly harden them into a form which upon weathering produces flags. At Igbobia in Adum district, however, an incipient spotted hornfels has resulted.

Mineralization.—Exact information respecting the lodes is as yet limited to those being developed at Nyeba and Ameka. Of the remainder we are dependent upon the material of the dumps of the old workings with one or two exceptions. The amount of ore left by the old miners was not great. They do not appear to have had any preference for either lead or zinc so that since in most cases the predominant minerals are galena and cerussite it is to be presumed that lead is the more important throughout the field. The old workings of Nyeba are typical of the majority, which is to say, the dump consists of altered shale, oxidized siderite, cerussite, and small cubes of galena coated with a white incrustation, probably lead sulphate. The primary lode may therefore be regarded as standard and as such will be described. The sulphides present are galena, sphalerite, and chalcopyrite (possibly only cupriferous pyrite). These are distributed throughout siderite. The upper portion of the lode is only a few feet wide, but is rich, galena being present almost to the exclusion of the other two sulphides. This rich band continues at depth while the lode rapidly increases in width. Appearances are that sphalerite and chalcopyrite increase in relative proportion in the outer portions of the lode, at depth, as a whole, however they are low grade. All three sulphides occur independently of each other in the gangue, but sphalerite is often included in galena.

The galena is of a number of varieties. The commonest is the well-developed crystalline form. This grades into a fibrous variety which in its turn may pass into a granular type. Occurring as small isolated masses within any of these forms is an extremely fine-grained steel grey variety having rather the appearance of a fracture surface of cast steel. Most of the material obtained from the dump of some subsidiary veins to the south of the main lode is of this last variety. The sphalerite has no property of special interest attached to it. It is a dark-coloured species displaying the usual resinous lustre and often exhibits a steely-blue

granular fracture surface. The oxidized zone of the lode consists of spongy limonite, throughout which is distributed cerussite in crystals or as a crypto-crystalline material intimately mixed with limonite. In this latter form it can be easily overlooked.

The Nyeba lode is interesting in that besides the main lode there is a subsidiary one about 10 ft. away on the footwall side, which even at a depth of 80 ft. is entirely cerussite and limonite. The amount of quartz so far encountered in the Nyeba lode is almost negligible. The main Ameka lode differs considerably. The chief gangue there appears to be quartz. Recent developments on the northern end at a depth of 80 ft. have exposed a number of separate ore-bodies. The largest and most westerly is a band of massive sphalerite with only a little galena, some 6 ft. in width. The percentage of zinc is high, and altogether this is an encouraging ore-body. To the east occurs a mass of rather fractured galena and beyond this another smaller body of this mineral. The most easterly body consists of marcasite. Unfortunately the inrush of water necessitated the abandonment of the cross-cut shortly after its completion. Material won from a point farther south consists of galena, sphalerite, and mammillary marcasite in about equal proportions, with a quartz gangue. The marcasite is suggestive of secondary sulphides but whether the galena and sphalerite are of this class cannot be said. In the massive zinc lode at 80 ft. cerussite is encountered. While from the examples of Nyeba and Ameka alone it might appear that zinc tends to be associated with quartz and lead with siderite material from a prospect pit at Mkpuma Akwatapka exhibits the opposite state of affairs. Sphalerite occurs in siderite, and galena, with a little chalcopyrite, in quartz. The lodes appear to have developed by replacement. Excellent examples of this phenomenon are obtainable at Nyeba and Mkpuma Akwatapka in which veins of siderite thread through shale in all directions, the textures of the latter being entirely unaffected. Quite small "horses" of undisturbed shale may occur in massive siderite.

The barren lodes offer an interesting and important problem. Their outcrops, almost invariably the sites of grassy hills or knolls, consist of a quartzose and ferruginous gossan which, in the case of the two highest hills on the Ugulangu group, attains considerable dimensions. The iron is present as limonite and possibly goethite. From some old workings at Ogbaka Hill and a defensive trench in a hill south of Mtezi oxidized siderite has been obtained, while the Mineral Survey discovered this material at Okpoto. Yet despite a diligent search upon all the lodes, numbering about twenty, not a trace of any lead or zinc material has been found. Significant is the fact that the old miners made very few attempts at working these bodies and that such pits as exist were probably dug to procure the siderite for iron smelting. The country rocks about the lodes are bleached, a feature common to the lead-zinc deposits. This is a phenomenon of weathering since at depth the shale is unaltered even in the smallest "horses". It might be argued that this bleaching was due to sulphide waters, but it could also come about by interaction of the silicates of the shale with carbonic acid formed in the oxidation of the siderite. One might postulate that, owing to the occurrence of these particular lodes upon hills, impoverishment of the metallic constituents through oxidation and solution had gone to completion. However, where the lodes occasionally outcrop in flat country there is no sign of lead, while again the oxidized minerals of lead are to all intent as insoluble as the sulphide. There is left the possibility that at depth sphalerite and perhaps marcasite are present in quantity but as neither has been found with the oxidized siderite, which was undoubtedly fresh when first exposed, the evidence indicates that the lodes are barren of economic minerals.

The appearance of the large lead-zinc outcrops before the workings were in existence can only be conjectured. A small stringer in the Adum district, entirely untouched except by farming operations, exhibits in the gossan large pieces of primary galena which, in fact, led to its discovery by the natives. A small but well defined lode in the same neighbourhood which was prospected some years ago contains galena and cerussite in the gossan almost on the surface. The Uburu vein was brought to the notice of the natives by the actual turning over the galena during the construction of their yam heaps. Close to Ikwo Court fragments of quartz containing galena occur. All this goes to prove that if a lode contains lead cerussite, and probably galena will be found on or close to the surface. The presence thus of unaltered galena with cerussite further proves that a true zone of oxidation is not developed. This is only to be expected in a country of high rainfall and low relief where the water table lies permanently close to the surface.

The disposition of mineralization along belts related to the structure has already been referred to and it has been shown that the two most important belts so far as the lead-zinc lodes are concerned are coincident with anticlinal regions. The majority of the important lodes strike to bearings ranging between 0°–180° and 330° and 150° and dip westerly at steep angles. This is suggestive that prior to their deposition a tension acting in a direction 90°–270° to 60°–240° weakened the shales and produced joints and faults of which the mineral solutions took advantage. There is some evidence that this weakening was regional. The barren lodes of Okoso Akau Hill, the Ugulangu and Onicha Hills, and the Okpoto and Mtezi districts can be enclosed within an elongated area running approximately north and south. Similarly the lodes of Ameka-Nyeba, Abakaliki and Mkpuma Akwatapka fall within another area trending the same way. This could be made to include the abundant quartz veins and igneous rocks of Odumoke district also. This tension does not appear to be complementary to the pressure which induced the fold system. It may be related to pitching, however, or to the horizontal bending of the fold axes, hence these structural features are worthy of detailed investigation from a purely economic point of view.

The locations of the barren lodes have been mentioned in a general way and it is not proposed to give them in detail. With the exception of those at Abakaliki and Okpoto the strikes do not lie N.N.W.–S.S.W., but at various angles not far removed from the N.E.–S.W. direction of folding. This rather indicates that they were not strictly contemporaneous with the lead-zinc lodes.

Economics.—The field as a whole is worthy of development. The amount of material removed

by the old miners is sufficient evidence to indicate that the larger lodes are workable and this is confirmed by recent developments at Nyeba and Ameka. Taking the extent of the old workings as a guide to the size of the ore-bodies the more important of these may be ranked thus :—(1) Ameka, (2) Mkpuma Akwaokuku (main lode), (3) Ameka East (all lodes), (4) Ekwa Abaja (all lodes), (5) Abakaliki, (6) Mkpuma Akwatapka, No. 1, Ollua or Nyeba (main lode). Nyeba, however, provides an example of surface indications which do not do justice to the underlying ore-body. The converse may be equally true. It must be recognized that where the old workings are wide the lode may be comprised of a number of parallel bands separated by country rock the whole of which had to be removed for convenience and safety in working. Such is the case at Ameka. It is not easy to give an opinion regarding the continuity of the lodes at depth. It is understood that some years ago the diamond drill proved the existence of zinc at 400 ft. at Ameka, hence so far as ore reserves are concerned the future of this mine seems assured. On the other hand, the lodes in general are certainly lenticular along the strike and the rapid increase of width of the Nyeba lode at small depths rather indicates a lenticular form vertically as well as horizontally. It can be said definitely that if the larger lodes are tabular bodies penetrating to some depth then as they stand they are exploitable. Yet if they are only lenticular we know that mineralization is spread over zones and there is accordingly the possibility of the existence of other large bodies at depth.

It is considered that for the immediate future prospecting would best be limited to the N.E.–S.W. belts indicated, and should commence from the mineralized areas at present known. In the north-west quadrant of Abakaliki Division the majority of the natives seem ignorant of the nature of lead ore and its abundant existence only a few miles away. This area is not promising though indications of mineralization occur at Odumoke. Igbago has not been investigated, but so far as is known lead has never been reported from there. It may be worth while to examine the country lying north-east of Nyeba and south of Mkpuma Akwaokuku and Ollua. The well marked association of mineralization and igneous intrusion should not be lost sight of. While the barren lodes give little promise of economic value it would be advisable to settle their nature by driving an adit at a small depth below the general level of the surrounding country into a typical example. The largest of the Ugulangu group would be suitable.

A NEW GUINEA GOLD MINE

In the *Chemical Engineering and Mining Review* of Melbourne for October 5 I. W. Morley gives a description of the property of Daydawn (New Guinea), Ltd., which consists of an area of approximately 200 acres situated astride the Merri creek, adjacent to its junction with Edie creek in the district of Morobe, Mandated Territory of New Guinea. It is situated at an elevation of about 6,500 ft. above sea-level.

Prospecting in this area is most difficult owing to the precipitous nature of the ground, which is covered with heavy timber and a deep layer of moss and humus. The rich alluvial gold deposits of Edie creek were discovered in 1926 and in the following year the " Daydawn " was discovered, the first known vein on this field. It was developed to some extent, but it was not till 1930, when the present company took charge, that its true value was realized. From that date its development has been rapid.

Geologically, the veins occur in a slate formation, associated with minor intrusions of porphyry. Three distinct veins are recognized in the property, the most important being the " Daydawn." This has an average width of about 3 ft. 6 in. and has been developed, carrying consistently high values, over a total length of 450 ft. to date. It has been opened up by several adits, giving backs averaging over 150 ft. in height. The vein material is, in the main, banded quartz and slate, but in the southern section of the mine the ore is rather manganiferous. The vein strikes north-east and has a dip of about 75°. The vein system is slightly faulted and, in part, split into branches. The other two occurrences are of a minor nature to date ; they have not yet, however, been developed to any great extent. Levels have been driven on the vein and rises have been put up at intervals of 50 ft. The ore is rill stoped, working from the rises. Surface material is broken and run in for filling, and sollars are laid on the filling to ensure the minimum loss of fines. Where necessary, light stulls are used to support the back. The ore is hand trucked to the mill. Hand steel is used for boring and the use of native labour has proved fairly successful in the underground work.

Consequent upon these favourable developments, it was decided to install a small power plant and mill. This consists of a 100 h.p. Babcock and Wilcox wood-fired boiler, specially designed for the altitude and transport by aeroplane and native carriers. This supplies steam to a 60 h.p. Belliss and Morcom high-speed vertical compound engine and also to various pumps and the electric light plant. The mill, which is belt-driven by the above engine, is a Taylor's Empire mill (similar to that in use at Mount Coolon, Queensland), 16 h.p., capacity 45 tons per 24 hours.

The ore from the mine is tipped into a bin, from which it is drawn through a grizzly and the oversize subjected to a preliminary crushing by a small jaw-breaker to about 2½ in. ring, from which it passes to the central feed distributor of the mill. The mill is 12 ft. in diameter, and consists of six 42 in. diameter crushing wheels shod with manganese steel tyres, and connected by shafting through trunnion bearings to a central boss, which is revolved at 9 r.p.m. These wheels run on an annular crushing bed, which has concentric with it two small amalgam troughs. The crushing weight consists of a steel tank, which can be loaded up to 10 tons. This is supported on springs, which, in turn, rest on bearings on the shafts of the crushing wheels. The ore is fed by the central distributor and delivered in front of the wheels. There is a grinding as well as a crushing action in this mill, and sizing tests show 70% minus 100 mesh after crushing. The ore is crushed wet, and since the gold

is "free" some amalgamation occurs in the mill, where 10% of the recovered values are obtained. The pulp is discharged (overflow discharge), and as a result of the wave action set up by the wheel travel a classifying effect is obtained. The pulp discharges on to copper amalgamation plates where 80% of the total recovered values are obtained. The tailings pass over blankets and a concentrate, which is treated in a large Berdan pan, is collected, giving the remaining 10% of the recovery. A total recovery of 94% of the gold content of the ore is being obtained. A feature of this mill is that in crushing clean quartz there is practically no sliming. The sands from the blankets are run to a tailings dam. It is anticipated that with the present plant it will be possible to treat profitably, in the future, ore of a similar nature as low grade as 35s. The results to date have been highly successful, and, it is anticipated, will shortly be returning substantial net profits.

Transport has been the deciding factor in the development of this section of New Guinea, and this company has expended on the transport of its plant from the coast over 55% of the total cost of installation. The well-nigh insurmountable difficulties encountered in this transport are not generally realized. As far as is known, this is the first milling plant in the world to be installed after transport by sea, air and land. The material and machinery was delivered at Salamaua on the coast and carried by aeroplane to Wau (35 miles air line; freight, 6d. per lb.). From Wau (3,500 ft.) to the property of the company is 3½ miles air line and 11 miles by mule track, a rise of 3,000 ft., and over this section the plant was transported by mules and native carriers (freight, 2d. per lb.). The whole plant has to be sectionalized to permit of this transport. The boiler above mentioned weighed 27 tons in all and the largest individual piece was ½ ton. For aeroplane transport it was necessary that the largest piece should not be greater than 7 ft. 6 in. by 2 ft. 6 in. by 2 ft. 6 in.

The company is at present employing 13 whites and 100 natives, and have erected commodious quarters and provided every possible convenience for the comfort of its employees.

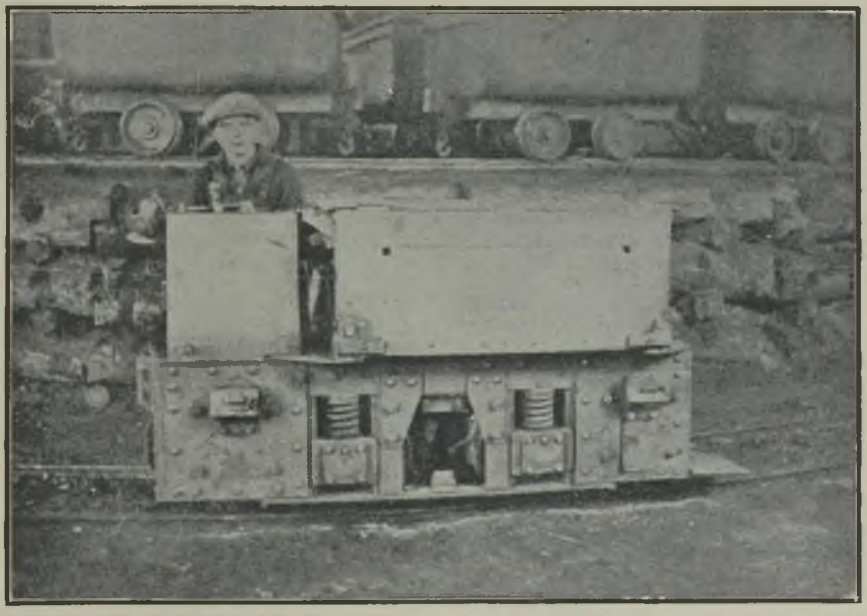
HAULAGE AT NORANDA

A description of the equipment and methods of haulage used at the Horne mine, Noranda, is given by B. Robinson in the *Canadian Mining Journal* for November. The author recalls that in December, 1927, electric storage battery locomotives were first introduced at the Horne mine of the Noranda Mines Ltd., situated at Noranda, Quebec. Prior to this date, during the period of development, hand-tramming had been found adequate in the handling of broken rock and ore from the development faces and chutes, to the shaft. Car hoisting was, and is yet, used to move the waste, concentrating ore, fluxing ore and direct-smelting ore to the surface. At the present time the mine is being served by two shafts:—No. 3 and No. 4. No. 3 shaft handles the ore requiring concentration, and the waste, in addition to men and supplies. No. 4 shaft handles the direct-smelting ore and the fluxing ore, the latter being a gold and copper-bearing rhyolite.

There were only two types of locomotion to be seriously considered. In choosing between the storage battery type of locomotive and the trolley type, there were five factors to be considered:

(1) *Safety.*—The balance of safety rested with the storage battery system.

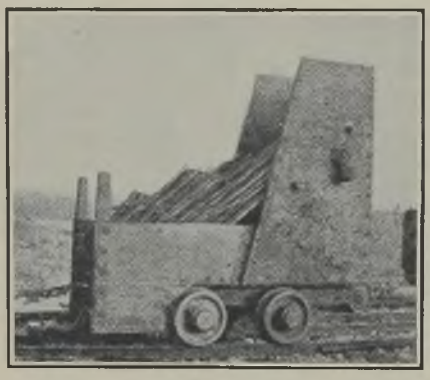
(2) *Initial Cost of Locomotive.*—In the case of the initial cost of the complete locomotive unit,



Storage Battery Locomotive Used Underground at Noranda.

however, the trolley locomotive was about one half of that of the storage battery locomotive complete and of equal capacity.

(3) *Cost of Installation.*—In the matter of the installation of the motor-generator sets for the two systems, the cost of that for the trolley type would have been almost double that necessary for the storage battery type. This is due to the fact that a large central motor-generator set is commonly used for the trolley system as compared with the smaller and more local sets used in the storage battery system. The installation of the complete trolley-wire system meant an expense which was absent in the storage battery system. In the trolley type, with the single larger generator set usually situated on the surface, extra power cables of large ampere capacity would have been necessary. In the case of ths storage battery system, the existing power cables for pumping purposes could be used. The cost of installing the charging panels with attendant cables for the various levels in the



Drill Steel Car.

storage battery system, was negligible compared to the installation of the trolley wire.

(4) *Cost of Operation, Maintenance, and Depreciation.*—It was evident that the cost of labour would be the same in either case. However, the cost of the operating power would have been greater in the motor generator sets for the trolley system than in the case of those of the storage battery system. Unless the range of the trolley locomotive was to be greatly restricted, subsequent development would necessitate considerable, and recurring expenditures. G. C. Newton has effectively summarized studies of the features and advantages of the two methods of electrical underground haulage.

(5) *Adaptability to Existing Conditions.*—A factor, specific to the Horne mine, was that of the adaptability of an electric locomotive system to the existing conditions of the underground workings. In the first place there were no long hauls. Long, comparatively permanent drives would have justified the trolley system of electric haulage. Due to the rather peculiar geological conditions, and shape of the ore-bodies, a system of " footwall " haulage levels was impractical and unnecessary. In the second place, were the trolley locomotive used, requiring a trolley wire and guard box, it would have been imperative to drill down the back in the majority of the haulage drives in order to ensure the safety of the men. A three rail system was, of course, out of the question entirely.

Having considered the above factors and having decided in favour of the storage-battery locomotive, there were several features, peculiar to the Horne mine, which required further consideration. At No. 4 shaft, the direct-smelting and the fluxing ores are hoisted in 3 ton, all-steel cars. The ore is unloaded by automatic cager, dumped by tipple, and returned to the 100 ft. level, where it is crushed. From this primary crusher it is taken to the secondary crushing plant on surface by means of an incline belt conveyor. This belt conveyor operates in a 400 ft. ramp, on a 29·2% grade from the 100 ft. level to the surface. The conveyor belt, in ramp and surface covered-way, has a total length slightly in excess of a 1,000 ft.

At No. 3 shaft, the concentrator ore is hoisted in all-steel, tipple type cars averaging 2½ tons per car. The waste is hoisted in all-steel side-dumping cars, averaging 1½ tons per car. The waste is taken to the rock dump, a round trip being about 2,000 ft. The concentrator ore is taken along a covered trackway to the mill crushing plant, the round trip being also about 2,000 ft. It was evident that some reliable method of locomotion was needed at No. 3 shaft. It was considered advisable to have the same type of motor on surface as underground, thereby ensuring the advantages of standardization of haulage equipment. With the subsequent increase in tonnage it has been found that the storage-battery locomotive, as used underground, has been able to handle any demands made upon it.

Locomotives.—In order to benefit by standardization, it was necessary to have a locomotive of an over-all length not exceeding the inside dimension of the cage. This gave a maximum permissible length of 6 ft. 7 in., a length not considered a stock size. The gauge of the underground track was to remain the same, namely 24 in., with the same weight of rail—30 lb. The specifications as required in this particular case were most closely approximated by those of a locomotive made by the Atlas Car and Manufacturing Co., of Cleveland, Ohio This locomotive is known as their Type A, Class 548, having a D.B.P. of 800 lb. at 3·5 m.p.h.

Each locomotive is equipped with two G.E.C. series motors, class G. E. 1091, Model No. 36 A 85, rated at 30 amperes, 80 volts, having a speed of 1100 r.p.m. Each motor is geared directly to a single axle. There has been some diversity of opinion as to the relative advantages of such a driving unit compared to one in which each motor is geared to both axles. It has been claimed that, with separate motors, one to an axle, one motor is apt to be overloaded, doing more than its proportionate share. However this arrangement has been found to give a most satisfactory performance during four years of continuous service.

In starting up from a dead stop the motors are in series, giving a high torque and a low speed for the initial heavy load. When once under way the motors are in parallel with the resultant low torque and high speed. The motors are controlled by a series-parallel type of controller, the change being effected automatically in advancing the controller arm.

Battery Details.—In considering the type of battery, it was decided to use the Exide Ironclad battery. The complete battery consists of 42 cells type M.V.A.-13, connected in series, the 42 cells being split up into three trays of 14 cells each. The normal service rating of the battery is 36

amp.-6 hrs. When fully charged, the specific gravity of the electrolyte is 1·28.

Despite the sturdiness, longer life and fool-proof nature of the Edison storage battery, several factors, in addition to initial cost, tended to weaken its comparison with the modern lead storage battery. The voltage of the lead battery tended to hold better, dropping off suddenly, whereas that of the Edison type nickel battery gradually diminished from full charge to exhaustion. The lead battery also proved to be better on the pick-up, having a " snappier " response, which is a property to be desired in the loading of cars at chutes.

Growth of Underground Service.—The first unit, consisting of four 3-ton locomotives and four batteries, was purchased in the autumn of 1927. Further additions have brought the total number of locomotives up to 10 and the number of batteries up to 20. Of these, all the locomotives and 16 batteries are still in use. Two of the locomotives and four of the batteries are being used at the collar of No. 3 shaft in transporting the waste to the dump, and the concentrator ore to the crushing plant. These locomotives have proved so satisfactory that they have been duplicated in the smelter for handling calcines from the roasters to the reverberatory furnaces.

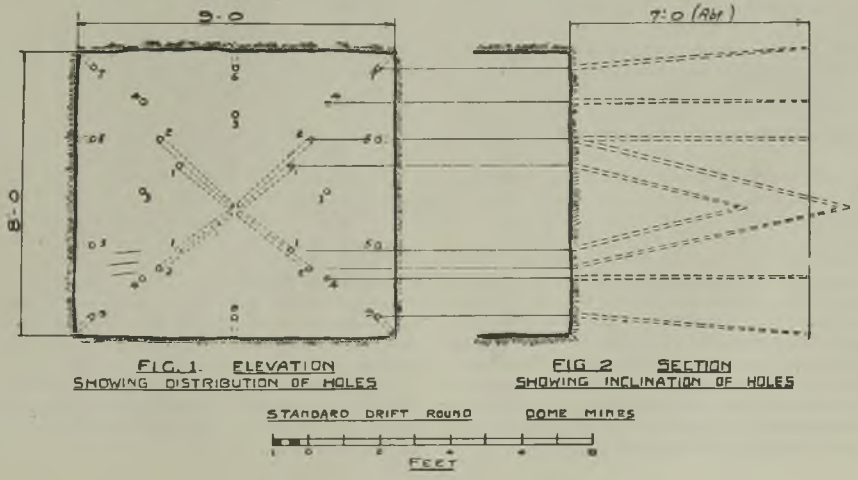
It will be noticed that in the first unit purchased there were no extra batteries. At that time it was found possible to keep the batteries charged between shifts and during the lunch periods. As development expanded, and production increased, the demand on the locomotives became greater, and it was found necessary to have extra batteries at the charging panels. At the present time the charging panels are served from two motor generator sets. One set is situated on the surface and the other on the 975 ft. level. The surface motor generator set has six leads from it—two for surface use, and one each to the charging panels on the 100, 200, 300, and 500 ft. levels. The set on the 975 ft. level has only two leads at present which serve the charging panels on the 725 ft. and 975 ft. levels. The surface motor generator set is an English Electric Co., combination, the 975 ft. level set being of Hartner Electric Company manufacture. These are served by a 550 a.c. line, and deliver 115 volts d.c. to the charging panels. The normal charging rate starts at 35 amperes, finishing off at 14 amperes. Facilities are such at the charging panels that an exhausted battery can be removed from the locomotive and replaced by a charged battery in five minutes.

Underground Details.—So far as the present routing arrangement and method followed in the loading and moving of train of cars is concerned, very little may be profitably explained due to the stage of development of the majority of the levels. A few facts however, may be mentioned. Each locomotive handles a train of seven of the 3-ton ore cars. Such a train is " spotted " in a drive from the chutes of which ore is being drawn. These cars are left to be filled by the attendant chute-pullers, who carry out any further car movements by hand. Ususally the train of seven cars is filled from three adjacent chutes. This reduces the time required to load, and saves labour in moving the full cars away from the chutes and replacing them with empty cars.

In the meantime, the locomotive has picked up a loaded train which it had previously spotted in another drive, or in another section of the same drive, and has taken it to the shaft station, where the automatic cager removes the empty cars from the cage and loads the full car onto the cage. Returning with a train of seven empty cars, the locomotive spots it for the loading and picks up a loaded train, previously spotted by the same locomotive.

The main haulage drives are double tracked, a crossover switch being placed every third chute, or every 90 ft., thereby facilitating the spotting and removal of cars.

Ground Breaking at a Canadian Mine.—The breaking of ground at the Dome Mines in the Porcupine mining district of Canada is described by A. R. Lawrence in the *Canadian Mining Journal* for December. The author says that the ground at the Dome mines is generally considered hard and tough. It is Keewatin greenstone, which has been subjected to intense schisting, the schistosity being parallel to the general strike of the ore-bodies. This has apparently added to the tenacity of the ground, making driving slightly more difficult than cross-cutting, due to the fact that the cuts



in drives do not pull as well as in cross-cuts, the difference being about 0·75 ft. per round in favour of cross-cuts.

Drives and cross-cuts are 9 ft. wide and 8 ft. high. This height is from top of rail to back, so that the actual ground broken to allow for rail and track tie is close to 9 ft. by 9 ft. The round used in driving these drives is standard, and consists of 25 holes. This includes 4 holes for a primary or " Chippy " cut. This chippy cut is a short diamond cut and is placed to break inside the regular diamond cut.

Drilling.—The work is done on contract. Two machine men and one helper have a clean face to set up, and they drill and blast their round in a shift. Two bars are used, one for each machine. They are 7 ft. 6 ins. long and are fitted with short cross arms. The back holes are drilled first, one machine taking the centre back hole and upper cut helper (marked 3 in Fig. 1). This machine then swings around the bar to drill the corner back hole. The face is drilled from top to bottom, the second machine drilling the centre lifter. The chippy cut holes are drilled 5 ft. deep, the second cut holes are about 8 ft. deep, and all the others are 7 ft. Each hole requires three changes of steel. The steel used is 1 in. quarter hexagon. The average drill speed is 9·5 in. per minute from the start of a hole to the finish.

Blasting.—By taking out the chippy cut first, the regular cut has something more to break to than one free face. It has been found imperative to get both cuts out well, and it is sometimes necessary to blast three or four times to do so. Blasting procedure usually consists of the three following operations :

1. Blasting chippy cut.
2. Blasting regular cut, including reblast of chippy, which is almost always necessary.
3. Blasting square up, including reblast of cut if necessary.

The sequence of firing the square up blast is as follows :

1. Cut helpers, marked 3 in Fig. 1.
2. Shoulder and knee helpers, marked 4.
3. Shoulder and knee holes, marked 5.
4. Back and lifters, in the order of their number in Figure.

Explosives.—The explosive used is 40% gelatin dynamite, which the contractors buy from the company. Consumption of powder is about 40 sticks per ft. of advance, or about 18·4 lb. A standard round takes about 240 sticks. Fuse is cut to 8 ft. lengths and is figured to burn 45 seconds per foot. Two fuses are used in each lifter to avoid missed holes. The lifters are invariably wet even though they are blown out with air before loading.

A round generally breaks over 5 ft., equal to about 36 tons, and is mucked by three muckers on the opposite shift who are also parties to the contract.

Gold-Milling at the Argonaut Mine.—Gold-milling practice on the Mother Lode as typified in the plant of the Argonaut Mining Co. at Jackson, Amador County, California, is described in Information Circular 6476 of the United States Bureau of Mines, by S. E. Woodworth. About 81% of the gold at this mine occurs as coarse and fine metallic particles scattered through large quartz veins and inclosing slates. The remaining 19% is associated with sulphide minerals.

The method of milling consists in crushing the ore to 2½ in. size by a jaw crusher followed by crushing in gravity stamps equipped with 24-mesh screens. Amalgamation is practised both inside and outside the stamp batteries. The tailings of the amalgamating plates are sorted in spitzlutte, which produce two spigot products and an overflow. The spigot products are concentrated on vanners. The classifier overflow pulp, after thickening in a cone, is concentrated by vanners. If the tailings of the vanners which treat the coarser sand products contain sufficient gold to warrant additional treatment, the combined tailings products of these vanners are ground in tube mills, after classification and dewatering in a rake classifier. The ground pulp after passing over shaking amalgamating plates is concentrated by tables. The classifier overflow pulp, after thickening, is treated on slime tables.

The concentrates are shipped to the Amador Metals Reduction Co. The general mill tailings are treated under contract in the cyanide plant of the Amador Metals Reduction Co.

In 1929, the mill treated an average of 246 tons of ore per day which contained $6·26 of gold per ton. The mill extraction amounted to 89·03% of which 64·89% was obtained by amalgamation and 24·14% by concentration. Milling costs for this period were $0·96 per ton of ore treated.

SHORT NOTICES

Shaft Sinking.—M. J. Elsing deals with the cost of shaft sinking in *Engineering and Mining World* for December.

Exploration.—Exploration methods and costs at a Colorado zinc mine are discussed by H. N. Lary in the December issue of *Engineering and Mining World.*

Teck-Hughes Mill.—H. N. Reed describes milling and cyaniding practice at the Teck-Hughes gold mines, Kirkland Lake, in the *Canadian Mining Journal* for December.

Selective Flotation of Lead-Zinc Ores.—C. Bruchhold describes the use of selective flotation methods in the dressing of oxidized lead-zinc ores in Mexico in *Metall und Erz* for December 1.

Temperature and Flotation Processes.—In *Metall und Erz* for December 1, Dr.-Ing. I. Huber-Panu discusses the influence of temperature on flotation.

Pulp Sampling.—In *Engineering and Mining World* for December, I. S. Heller describes methods of automatically sampling and distributing pulp.

Coal Treatment.—Jigging, classification, tabling, and flotation tests on coals presenting difficult washing problems are described in Bulletin 337 of the United States Bureau of Mines.

Lubricating Wire Ropes.—In the *Chemical Engineering and Mining Review* of Melbourne for November 5 last, a description is given of a compressed air-spray outfit for the lubrication of mining cables.

Dust in Mine Air.—W. J. Walker and A. O. G. Le Roux give the results of some experiments on the elimination of dust in mine air in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa for October, 1931.

Michigan Copper Deposits.—Fissure vein and lode relations in Michigan copper deposits are described by T. M. Broderick in *Economic Geology* for December.

Chromite.—E. Sampon deals with varieties of chromite deposits in *Economic Geology* for December.

Rhodesian Copper Mining.—The history and prospects of copper mining in Northern Rhodesia are discussed by A. Chester Beatty in *Mining and Metallurgy* for December.

Mining and Treatment of Boleo Ores.—A description of operations on the property of the Compagnie du Boleo, prepared by the Staff of the company, appears in *Engineering and Mining World* for December.

Sulphur in Gasoline.—In Technical Paper 513 of the United States Bureau of Mines, R. H. Espach and O. C. Blade, present a study of methods of determining sulphur in petrol.

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.*

15,836 of 1930 (359,923). New Jersey Zinc Company, and L. E. Teter, New York. Zinciferous material containing cadmium is sintered by blast-roasting in the presence of a chloridizing agent, whereby a substantial elimination of cadmium is effected without objectionable loss of zinc.

18,362 of 1930 (359,478). D. Tyrer and Imperial Chemical Industries, Ltd., London. The temperature of combustion of ferrous sulphide in air is controlled by feeding to the reaction zone a relatively cool gas consisting of sulphur dioxide and nitrogen, whereby fusion of the sulphide is prevented and an iron oxide obtained which is substantially free from sulphur.

24,057 of 1930 (360,899). A. H. Verrill, London, sulphur-bearing ores of low grade are placed on a grid over a bath containing an aqueous solution of lime and soluble silicate, and heated by steam, the molten sulphur falling into the bath and thus being freed of deleterious dust.

1,526 of 1931 (360,746). Zinkhütte Neu-Erlaa G.m.b.H, Austria. An improved process for the manufacture of zinc oxide, which renders the production of a pure oxide possible without the preliminary elimination of cadmium-containing zinc dust.

3,108 of 1931 (360,758). Siemens and Halske A.-G., Berlin. Alkali-beryllium-fluorides, produced by the decomposition of beryl with alkali-silico-fluorides, are treated with strong alkali lyes, containing the same alkali as the double fluoride, and are completely decomposed, the alkali beryllate being recovered by filtering or centrifuging.

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.

Deep Borehole Surveys and Problems. By M. H. Haddock. Cloth, octavo, 296 pages, illustrated. Price 21s. London: McGraw-Hill.

German-English Geological Terminology. By Dr. W. R. Jones and Dr. A. Cissarz. Cloth, octavo, 250 pages. Price 12s. 6d. London: Thomas Murby and Co.

Lehrbuch der Markscheidekunde. Part II. By Dr. P. Wilski. Cloth, octavo, 270 pages, illustrated. Price RM. 34. Berlin: Julius Springer.

Water Diviners and Their Methods. By Henri Mager. Cloth, octavo, 308 pages, illustrated. Price 16s. London: G. Bell and Sons.

The Geology of the Whitehaven and Workington District. By T. Eastwood, E. E. L. Dixon, Dr. S. E. Hollingworth, and Dr. Bernard Smith. Cloth, octavo, pages xvii + 304, illustrated. Price 6s. London: H.M. Stationery Office.

The Mining Laws of the British Empire and of Foreign Countries. Vol. X. **New Zealand.** Prepared for the Board of Governors of the Imperial Institute. Paper boards, 503 pages. Price 30s. London: H.M. Stationery Office.

Mining Examinations: Examinations for Certificates of Competency and Surveyors' Certificates under the Board for Mining Examinations, November, 1931. Paper folio. Price 1s. 6d. London: H.M. Stationery Office.

Chrysotile Asbestos in Canada. By J. G. Ross. Paper covers, 146 pages, illustrated. Price 25 cents. Ottawa: Department of Mines.

Canada: Department of Mines. Investigations in Ceramics and Road Materials, 1928–1929. Paper covers, 143 pages, illustrated. Ottawa: Department of Mines.

Nova Scotia: Annual Report of the Mines, 1930, Part 2, containing Reports on the Potash Possibilities of the Province and on the Salt Spring of the Oxford District by A. O. Hayes; a Report on the Cheverie, Windsor and Shubenacadie Basins, by W. J. Wright; and a Report on the Gautreau District, by A. O. Hayes. Paper covers, 147 pages, with maps and plates. Halifax: Department of Public Works and Mines.

Tanganyika Territory: Land Development Survey, Fourth Report, 1930, Mbulu District. Paper covers, 16 pages, with map. Price 3s. London: Crown Agents for the Colonies.

Western Australia: Report of the Department of Mines, 1930. Paper folio, 48 pages. Perth: Department of Mines.

Mineral Resources of the United States, 1930. Part I, pp. 31–56, Mercury, by P. M. Tyler. Part II, pp. 101–110, Graphite, by J. Middleton; pp. 111–116, Silica, by E. R. Phillips. Washington: Superintendent of Documents.

Warning Agents for Fuel Gases. United States Bureau of Mines Monograph No. 4. By A. C. Fieldner, R. R. Sayers, W. P. Yant, S. H. Katz, J. B. Shohan, and R. D. Leitch. Paper covers, 177 pages, illustrated. New York: American Gas Association.

Mining Shares: Highest and Lowest Prices, Dividends, etc.; for past six years. Mid-December, 1931. Paper covers, 110 pages. Price 2s. London: Fredc. C. Mathieson and Sons.

Kingston's Dollar Equivalent Tables: At Eighteen Rates of Exchange. Price 2s. London: Kingston's Translations Institute.

COMPANY REPORTS

Messina (Transvaal) Development. — This company was formed in 1905 and works copper properties in the Transvaal. The report for the year ended June 30 last shows that the total ore production, including ore from development, amounted to 313,220 tons, averaging 2·89% copper, of which the Harper mine produced 97,867 tons, averaging 3·91% copper, and the Messina mine 215,353 tons, averaging 2·42% copper. The tonnage

treated by the concentrating plant was 313,383, the production of hand-picked ore and concentrates being 16,553 tons, averaging 52·73% copper. At the smelting plant 8,706 tons of ingots was produced, averaging 99·89% copper. The accounts for the year show a profit of £29,145, the carry forward being increased to £53,610. The ore reserves at the end of the year were estimated to be 1,241,379 tons, averaging 2·75% copper, as compared with 1,155,312 tons, averaging 2·77% copper, at the end of the previous year.

Sulphide Corporation.—This company was formed in 1895 to work the Central lead-zinc-silver mine at Broken Hill, New South Wales. It also operates the Cockle Creek works in New South Wales, a zinc works at Seaton Carew, and is interested in the Nantymwyn lead-zinc mine in Wales. The report for the year ended June 30 last shows that mine production was limited to the first half of the period under review, 73,438 tons of ore being raised during that period, as compared with 133,338 tons during the whole of the previous year. The average grade of the ore was: Lead, 14·3%, zinc, 14·4%, and silver, 11·3 oz. per ton. The ore reserves at the end of the year were estimated to be 707,834 tons, no ore having been developed during the period. The tonnage of Central mine ore treated at the mill was 73,342, a small amount of Broken Hill Proprietary Mine ore and Block 14 Mine ore, being treated in addition, the total amount milled being 77,303 tons. Lead concentrates produced amounted to 12,971 tons, assaying 70·3% lead, 7·0% zinc, and 53·5 oz. silver per ton, while 17,157 tons of zinc concentrates, assaying 52·7% zinc, 2·3% lead, and 4·4 oz. silver per ton, were also produced. At the acid plant 2·45 tons of sulphur were burnt for a production of 9·75 tons of sulphuric acid. At the Cockle Creek works the acid position was affected by general industrial conditions, but increases were registered over the previous year, although the superphosphate production at 30,138 tons showed a further reduction of 4,213 tons. At Seaton Carew, work continued until January, 1931, from which time operations were confined to the roasting of zinc concentrates for the production of sulphuric acid. The operations of the corporation for the year resulted in a loss of £67,668, as compared with a profit of £72,593 in the previous year. The adverse balance has been carried to the "accumulated profits account," reducing the credit on that account to £29,428.

Hongkong Tin.—Formed in 1927, this company works alluvial tin property in the State of Selangor, F.M.S. The report for the year ended August 31 last shows that the dredge treated 1,258,180 cu. yd. of ground, recovering 904 tons of tin oxide, the average gross price realized being £82 13s. 4d. per ton. The area of ground broken at surface during the year was 11·88 acres. During a period affected partly by restriction, the net profit for the year was £24,253, which, with the balance brought in, gave an available total of £28,913. Of this amount £15,000 has been distributed as dividends, equal to 10%, and, after making various allowances, the carry forward is increased to £8,414.

Kamunting Tin.—This company was formed in 1913 to work alluvial tin properties in the F.M.S., but was amalgamated with Pangnga River Tin Concessions in September, 1930, details being published in MAGAZINE for October, 1930. The report of the company for the year ended June 30 last shows that 2,144,000 cu. yd. was treated at Kamunting and 1,339,000 cu. yd. on the Pangnga property, the total output being 1,228 tons of tin ore of a value of £86,563. The profit for the year was £32,694, which, with the balance brought in, gave an available total of £70,636. Of this amount £11,778 has been appropriated for debenture redemption and interest, and the balance of £58,857 was carried forward.

Pattani Tin.—This company was formed in 1930 and owns alluvial tin-mining properties in Siam. The report for the period from September 22, 1930, to June 30 last shows that dredging was commenced in August, 1930, the ground treated during the period under review amounting to 1,586,000 cu. yd. Tin ore recovered amounted to 337 tons, the average net price realized being £67 4s. 11d. per ton, costs over the same period averaging £63 5s. 2d. The area has now been closed down pending an improvement in metal prices.

Apex (Trinidad) Oilfields.—This company was formed in 1919 to acquire oil rights in the Fyzabad district, Trinidad. The report for the year ended September 30 last shows that the production of crude oil was 522,194 tons, as compared with 425,036 tons in the previous year. The casing-head gasoline plant was started in November, 1930, and is giving satisfactory results. The continued fall in the market value of oil materially reduced prices realized during the year, but this was met by the increased production, the oil profits for the year amounting to £335,236. After allowing for amortization, etc., the net profit was £188,391. Dividends paid during the year absorbed £100,000, equal to 20%.

DIVIDENDS DECLARED

Ashanti Goldfields Corporation.—40%, less tax, payable January 29, and bonus of one share for each three shares held.

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

Burma Corporation.—2¼d., free of tax, payable February 15.

Cam and Motor.—2s., less tax.

Chinese Engineering.—6d., free of tax, payable December 29.

Great Boulder.—3d., less tax, payable January 30.

Hongkong Tin.—3d., less tax, payable January 7.

Kamunting.—3%, less tax, payable December 29.

Pangnga.—1½d., less tax, payable December 29.

Rezende.—2s. 6d., less tax.

Sherwood Starr.—9d., less tax.

Zinc Corporation.—Pref. 2s., less tax, payable January 4.

COMPANIES REGISTERED

Cyprus and General Asbestos.—Incorporated in Cyprus on July 27, 1931; particulars filed November 26, 1931. Capital: £750,000 in £1 shares. Objects: To acquire the undertaking of the Cyprus Asbestos Co., Ltd. Directors: Lord Inchcape, W. T. Greenwood, F. C. Jenkins, H. L. Jones, and Sir Thomas Royden. London Office: 49, St. James's Street, S.W. 1.

H.E. Proprietary.—Capital: $300,000, in 10s. shares. Objects: To acquire the assets of H.E. Proprietary (New). Office: 39-41, New Broad Street, E.C. 2.