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EDITORIAL

AN addition to their increasing list of standard text-books has been made by Mining Publications, Ltd., proprietors of THE MINING MAGAZINE. Mr. F. A. W. Thomae's "Power Plants on Metal Mines," which appears this month, presents a useful assembly of data on power plants, such as is required for the conduct of mining operations of various kinds in different parts of the world.

THE new building in South Kensington that is to house the Museum of Practical Geology and the Geological Survey of Great Britain is approaching completion, but it is not to be used at first for the purpose for which it is intended, since the authorities have decided that it is of a size and dignity fitting for the assembly of the delegates to the World Economic Conference. Having regard to the age-old rivalry between pure and economic geologists, this "house warming" is not without its humour.

AS far back as March, 1930, reference was made in the MAGAZINE to the inadvisability of American engineers working in Russia, mainly on ethical grounds, a view which was subsequently supported by the American press for reasons of personal safety. The unfortunate experience of the Metropolitan-Vickers engineers has brought this home to those in this country in a way nothing else could have done and it occasioned no surprise that the action of the U.S.S.R. should be condemned at the dinner of the Institution.

EARLY this month it was announced that a new agreement had been concluded between the Anglo-Persian Oil Company and the Persian authorities. Full details of the conditions attached to the granting of the new concession are not to be published until they have been ratified by the Persian Medjliss, but it is understood that the company has agreed to give up certain portions of its concession that cannot be worked immediately, to pay additional royalties and a larger amount of its profits to the Persian Government, to relinquish its sole right to instal pipelines, and to guarantee exchange losses on payments to the authorities.

THE Colonial Office stated early this month that the recommendations of Sir Albert Kitson in his report on the application of Tanganyika Concessions, Ltd., for an exclusive prospecting licence over an area of approximately 5,900 square miles have been accepted by the Government of Kenya and the Secretary of State for the Colonies. The report was reviewed in the MAGAZINE for February last and of the two areas there mentioned that were to be thrown open to general prospecting that embracing the Gori goldfield is to be opened on June 1. Plans with respect to the second area, covering the westward and south-westward extension of the Kakamega field, are to be announced in due course. Meanwhile, Tanganyika Concessions, Ltd., is to tender for one of the other three areas mentioned in the report.

IMPENDING changes in the direction of the Camborne School of Mines were referred to in the MAGAZINE in March. The appointment of Major H. Standish Ball as principal is now announced. The new principal received his early training at the South African School of Mines and Technology, now the Witwatersrand University, where he was awarded a research fellowship and the gold medal of the Transvaal Chamber of Mines. Post-graduate research took him to the McGill University, of which he was awarded the M.Sc. degree. Major Ball's professional work before the War—in which he served with distinction in the Royal Engineers, being mentioned four times in despatches and receiving the O.B.E.—was with the Rand Mines group in various capacities. After the War he was associated with the François Cementation Company for a time before proceeding to the Trinidad oilfield. A period of reporting work in Canada intervened and he then returned to South Africa as chief surveyor and acting manager of the Sub Nigel, leaving this work to return to oilfield practice, this time in Venezuela, where he was engaged until recently as the resident managing director of his company. It will be evident from this brief review that the new principal is a man of wide experience and the school is to be congratulated on the appointment.

THE annual dinner of the Institution of Mining and Metallurgy, held on April 26, at Grosvenor House, Park Lane, was well attended. In proposing the toast of the Institution Sir Hugh O'Neill, who has been closely connected with the profession for some years, naturally referred at some length to the gold-mining industry, which he felt was a legitimate business if properly carried on, especially as a larger output of the precious metal was likely to solve many of the difficulties facing the world. Dr. Sydney Smith, the president, lately returned from Canada, where he has represented the Institution at the Canadian Institute's Annual Convention—reference to which is made by our Toronto Correspondent in his letter in this issue—responded and, in expressing the hope for better times for the base-metal miners, was equally anxious that the good time for gold should continue. He recalled that in his presidential address a year ago he had suggested that a review of our resources of individuals was necessary, as so much experience was waiting to be used, and he believed that this was wanted more than ever at the present time. Speaking of his experiences in Canada, Dr. Smith was enthusiastic as to his welcome and as to the large and well-attended meetings, always held in an atmosphere of loyalty. Returning to a discussion of present-day conditions, Dr. Smith, rejoicing to see so many representatives of the other professions present, pleaded for a greater degree of co-operation with other professional bodies. The toast of the guests was proposed by Mr. G. W. Gray, who referred to the time-honoured partnership of the miner and the "adventurer" and expressed his pleasure at seeing so many representatives of their partners present. He welcomed the guests representing kindred professions, referring specifically to Sir Murdoch MacDonald, president of the Institution of Civil Engineers, and to Major-General R. N. Harvey, as representing the military engineers. Finally Mr. Gray said he felt that he voiced the opinion of all present when he condemned the action of the Soviet Government in Russia with regard to the Metropolitan-Vickers employees. Engineers were, he felt, above all citizens of the world and such conduct as that of which they had been accused was absurdly impossible. It is hardly necessary to add that Mr. Gray's views met with general acceptance.

Drill Steel

Of the many subjects that might be chosen for discussion by mining engineers there is, perhaps, none of such general interest as that of drill steel, its composition and its handling, both above and below ground. To many engineers, particularly those on smaller mines, the refinements of heat-treatment and the niceties of small differences in composition mean little or nothing, all that such operators require being a dependable tool for rock breaking and one that will stand rough usage in the hands of the unskilled or partially-trained artisan. As all ore must be broken, however, all mining men are interested in steel and that the subject was welcome to them was borne out by the attendance at the April meeting of the Institution, when Dr. W. H. Hatfield, Director of the Brown-Firth Research Laboratories, introduced his paper "Drill Steels for Mining Purposes."

The author has attempted to treat the matter from all possible angles. First he reviews the mechanism of the operation of drilling, describing the nature of the tool and the manner of its operation. He then discusses the steels actually used, the characteristics they should possess, as well as those obtained under operating conditions, and touches on the metallography. Next he sets out his own experience of troubles and defects and concludes by a consideration of other steels which might be employed and a review of the methods used in the manufacture of hollow bars. Taking these points in turn, although Dr. Hatfield was probably correct in endeavouring to present a complete exposition of the subject and in opening his paper by a restatement of the problem of drilling was imparting a fullness to it, the second part, that dealing with the steel employed and its treatment, was doubtless of greater interest to the practising engineer.

The varying requirements of engineers on different mines must be obvious. On a small mine there are frequently no means for treating the steel as it should be treated, all that is required being reliability and a capacity to stand up to rough handling. On a large mine, however—a Rand mine, for example—there are at hand the means for caring for the steel as the maker would like it to be cared for. It is evident, therefore, that Dr. Hatfield's discussion of this part of his paper will to the average mining man appear somewhat idealistic. It is, in fact, the maker's view, or, better, the view of the

metallurgist, who naturally dislikes to see good material badly handled. His exposition of correct treatment is thorough, but can obviously only appeal to the practical miner in such varying degree as he will have the means to carry out the author's recommendations. For example, Dr. Hatfield pleads that the drill rod itself should be just as carefully treated as the "business end"—the bit. Such a recommendation can only be carried out by the operator on a large, well-organized property, the small mine worker being usually content—perforce—to see that the "business end" is properly made and tempered. As to the composition of the steel, although refinement will appeal to the metallurgist, who feels quite sure that the material commonly used is not necessarily the best that could be used for the purpose, the practising mining engineer calls for a combination of two things only—cheapness plus reliability.

There is one point that the author appears to have driven well home and that is the importance of the manner of manufacture of the central hole in the hollow steel now in almost general use. Corrosion fatigue may be a vague term—even, apparently, to metallurgists—but at least it does define a cause of failures in hollow drill-steels and a reason for the care taken by present-day manufacturers in the preparation of the central hole. Here again it might be felt that the refinements of manufacture and the composition of the hole lining could be left to the metallurgists, all the mining man will require to know being that his steel will have a smooth core lined with a metal not likely to crack and well able to withstand corrosion. Discussing failures, the author remarks that most of these are due to fatigue or wear. A drill kept in use after it has become blunt is subject to more severe impact and has little penetrating effect, which leads to unnecessary breakages caused by the waves of stress set up in the drill. Again, heat treatment or annealing of the whole bar is recommended, a matter which can be left to those able to carry out such a course. Brittleness through overheating in forging or hardening is another cause of failure, while a wrongly-shaped tool may be a fruitful cause of trouble, especially where any re-entrant angles are incorporated in its design. Finally there may be initial faults in the manufactured bar, a cause of failure which is, however, comparatively rare. The discussion of other available steels comes at the end of the author's paper. The average mining man, while agreeing that his present steel may not be the best the manufacturer can supply, will doubtless want convincing that any new steel offered will improve upon it. He wants a steel that will respond readily to routine treatment, that is reliable, and that is reasonable in price. The tungsten, molybdenum, and other alloy steels can, in his opinion, wait until they are proved.

Dr. Hatfield was, in the absence in Canada of the president, Dr. Sydney Smith, introduced by Professor Sir Harold Carpenter, who took the chair at the meeting. The author in his opening remarks illustrated by means of lantern slides the main points of his paper, emphasizing the two which have already been stressed—*i.e.*, that a plain carbon steel was what the miner evidently wanted and that such a steel should be treated in a specified way, but it should be realized that this was not the best that the metallurgist could do for him. The discussion was opened by Dr. Cullen and he was followed by Mr. F. W. Harbord, who referred to the findings of the Johannesburg Commission on drill steels, although Mr. C. B. Brodigan, who came next, pointed out that this commission sat in the days of solid steels and hand drills. Mr. Brodigan felt that the author had been somewhat unkind to the larger mines, where the shank and drill rod were as carefully tended as the bit, although such an ideal system was perhaps not universally applicable. Dr. Desch and Mr. Jennings, who followed, referred to work with similar steels in coal-cutting machines and boring-tool bits, but Professor J. G. Lawn, returning to the mining man's point of view, suggested to the author that what was wanted was not a general drill steel, but a series of steels. The main point, Professor Lawn thought, was that all steels should be sent out with full particulars of how they should be treated and then the manufacturer would find that they would be carefully handled. As it was treatment was left largely to the engineer and could never be uniform. At this stage Mr. E. F. Law contributed a humorous interlude on razor-blades as an example of fatigue in metals, while Mr. G. D. Baker, who followed, described the process of hot milling as applied to drill sharpening. After further remarks by Mr. A. J. Bensusan and Mr. Sargeant, representing Sir Robert Hadfield, the author replied to some of the points that had been raised, although these were so numerous that his main reply is

reserved. It was a compliment to the author that his was the only paper and that its presentation and discussion profitably occupied all the available time.

British Standard Sieves

A review of the many difficulties in the way of the standardization of sieve sizes appeared in these columns in September, 1930, while the subject was again examined in June, 1931, when it had become perfectly plain that the day of the old I.M.M. series was over. It will be recalled that in its annual report issued in May, 1931, the council of the Institution announced that it had decided to discard the I.M.M. series of sieves and to adopt the new B.E.S.A. series—that of the British Engineering Standards Association, as it then was. This is the specification that has now been issued by the British Standards Institution and its issue means so much that it seems worth while to return to the subject.

Although the I.M.M. series has now almost become a thing of the past and with it its outstanding advantages, it is, perhaps, fitting that these advantages should be recapitulated. This series of sieves, which has been available since 1907, measures the aperture in terms of the inch, each successive member being a round fraction of the unit, and thus it had the important advantage that the mesh figure was an exact measure of the aperture. To quote an example previously given, the 20-mesh screen had 20 apertures and 20 wires to the inch, each aperture being, therefore, $\frac{1}{40}$th of an inch. This plan, of course, had the definite disadvantage of seriously limiting the available screen area, a serious fault in commercial work, so that when the selection of a new series arose a new specification was prepared by the two delegates of the Institution on the B.E.S.A. Committee examining the question. In preparing this new series, fully reviewed in the MAGAZINE for June, 1931, it was realized that screening area would have to be increased and that additional sizes would have to be allowed for, but an attempt to preserve a definite relationship between mesh-number and product-size was eminently successful. Nevertheless it was resolved to scrap this new series with the old for the sake of uniformity and the standard series of which the specification has just been issued proposes apertures equal to those of the United States Bureau of Standards sieves and of the same range. The wire gauges of this country, however, and the wire-weaving conventions employed here differ from the American and consequently the mesh numbers of the two series cannot be the same. In other words, the step towards uniformity has been only partially successful. For this reason the loss of the I.M.M. sieve with its sensible relationship of mesh-size to product-size is more difficult to bear, for manufacturers in this country had grown used to it and it was in standard use in many parts of the world. Whether the new B.S. sieves will bring work to this country and its manufacturers or whether they will become widely used remains to be seen, but it is difficult not to feel that more and more people will use, not the B.S. sieves or even the U.S. Bureau sieves, but the Tyler series, so widely employed on the American continent. This series, already well-tried, has a selling organization firmly established behind it, so that the new B.S. sieves have a long and hard row to hoe.

Certain features of the B.S. specification may be detailed here. To meet the demands of industry it has been found necessary to include two series of woven-wire sieving materials characterized by (1) the clear mesh or aperture dimension expressed in inches and (2) the number of meshes per linear inch. In addition, provision has been made for two or more sizes of wire in the coarser meshes, which has made it necessary to include the wire sizes in the designation or B.S. number—that is, either the aperture dimension and the S.W.G. (or diameter of the wire) or the number of meshes per linear inch and the S.W.G. of the wire, the use of S.W.G. numbers and the specification of mesh-numbers rendering the progression of the sieve series somewhat less uniform than it might have been had special wire sizes and odd counts been adopted. As regards perforated plates, it has only been found possible to standardize with those having round holes staggered at 60°. The materials used in manufacture cannot be standardized, but it is pointed out that steel wire up to 90 mesh, copper wire up to 100 mesh, brass wire up to 200 mesh, and phosphor bronze wire up to 300 mesh are usually stocked by makers. At the present stage it is impracticable to lay down tolerances for standard sizes, but the British Standards Institution invites co-operation of both manufacturers and users in this matter, hoping to be able to revise the specification after one or two years' experience has been gained.

REVIEW OF MINING

Introduction.—The most important event of the past month has been the reimposition of the ban on gold exports by President Roosevelt after a modification of only a fortnight. The resultant devaluation of the dollar has created a general weakness in the gold currencies and it is expected that stabilization will form one of the main topics at the World Economic Conference, which is to meet in London on June 12, although the lines along which the vexed question of War Debts is to be settled have still to be determined. Whilst the Budget has been presented during the past month, it contained nothing of outstanding importance. Base metals have generally improved, following the lead of tin, which has advanced markedly in price since the quota for the 14 months ending August, 1934, has been fixed at 33⅓% of the 1929 standard, particularly as the world visible supplies have shown a material decrease. The position of copper is less settled, however, as inflation in the United States may postpone the proposed closing of the mines there.

Transvaal.—The output of gold on the Rand for April was 845,099 oz. and in outside districts 49,998 oz., making a total of 895,097 oz., as compared with 946,863 oz. in March. The number of natives employed in the gold mines at the end of April totalled 225,279, as compared with 223,490 at the end of March.

The reports of the Rand mining companies covering the three months to March 31 show that the general practice has been to calculate payable development footages as formerly and not so as to include the lower values now payable at the enhanced price of gold. Mining profits are generally much higher, but there has been a steady decline in the yield-per-ton figure since the industry's policy in regard to low-grade ore working has been declared, while the drop in development footages has shown that efforts are largely concentrated on exploiting low-grade ore. The report of the Modderfontein East, Ltd., states that application has been made to the Government to lease approximately 625 claims adjoining the company's eastern boundary; later news is to the effect that this has been accepted. There have been good developments on the Sub Nigel, while that company's newly-acquired lease area on the farm Grootfontein was penetrated at two points from 28 East cross-cut North.

Two companies, East Geduld Mines and Grootvlei Proprietary Mines, announced last month that they proposed to raise additional capital for shaft-sinking purposes. The directors of East Geduld Mines decided to proceed immediately with the sinking of a second vertical shaft and for this purpose the capital of the company has been increased by 240,000 ordinary £1 shares to £1,800,000, the new shares to be subscribed for and issued as required. For sinking a vertical shaft on the Grootvlei property the directors have decided to issue a total of 550,000 new shares, which will be subscribed for by the Union Corporation and its associates.

At the annual meeting of Simmer and Jack Mines, Ltd., it was announced that it had been decided to effect certain alterations and additions to the reduction plant in order to bring its normal capacity up to 85,000 tons per month.

Arrangements have been made for unwatering the bottom levels of the Rose Deep mine and for further equipping the incline shaft, while application has been made for 129 claims south of the present boundary and an arrangement made with the East Rand Proprietary whereby the Rose Deep would acquire 98 claims, which would allow of the lateral extension of development from the Lohse incline shaft.

The New Steyn Estate Gold Mines, Ltd., is to acquire the property and plant of the old Roodepoort United mine and lease additional ground to the east. A new shaft is to be sunk, while the old ones will be reopened to advance development.

The proposed capital reduction of the East Rand Consolidated, announced last month in the MAGAZINE, has been confirmed by the Court.

The accounts of the Rand Selection Corporation, Ltd., for the year to September 30 last, show a profit of £150,365, which, added to £92,528 brought in, gave an available total of £242,893. Of this £150,000 has been transferred to a special reserve against exchange fluctuations and the balance of £92,893 carried forward.

Southern Rhodesia.—The output of gold from Southern Rhodesia during March was 49,929 oz., as compared with 47,661 oz. for the previous month and 47,239 oz. for March, 1932. Other outputs for March were: Silver, 8,442 oz.; coal, 37,398 tons; chrome

ore, 2,486 tons ; asbestos, 2,256 tons ; tin, 1 ton ; iron pyrites, 1,052 tons.

The action between the Globe and Phœnix Gold Mining Company and the Rhodesian Corporation was settled last month in favour of the former company, the Court holding the case to be " not proven." An appeal is to be made.

Northern Rhodesia.—During the three months ended March 31 last the Roan Antelope mined and milled 441,700 short tons of ore averaging 3·70% copper and produced 9,823 long tons of blister copper at a total cost, excluding debenture interest and depreciation, of £21 16s. 4d. per long ton. Appended to the report is an estimated revenue and expenditure account covering the nine months to March 31 last, which shows a surplus over working expenditure of £211,589. This figure is reduced to £114,769, after allowing for quota payments to the Rhodesian Selection Trust and for debenture interest, and is subject to depreciation and taxation.

The report of Mufulira Copper Mines, Ltd., for 1932 shows that the share capital has been increased to £825,563 12s. by the issue of a further 25,000 shares at £1 per share to Rhodesian Selection Trust, Ltd., Rhokana Corporation, Ltd., and the British South Africa Company. The plant has been kept in good order, while 48,881 dry short tons of stock pile ore were sold during the year to the Rhokana Corporation.

The North Charterland inquiry was reopened on May 10.

Gold Coast.—The Ashanti Goldfields Corporation announced last month that the Cote d'Or reef in the main cross-cut on No. 11 level averaged 9 ft. in width and assayed 68 dwt. Further advice as to developments on this level was contained in the April return, where it was stated that the same reef in cross-cut No. 1 S.W. averaged 7 ft. in width and assayed 145 dwt.

The report of Bibiani (1927), Ltd., for the year to September 30 last shows that the new power plant is now running, the treatment plant completed, and test runs being made. It will be recalled that the capital of the company was increased to £400,000 in January last, the issued capital at the end of March being £397,961. Development work on No. 3 level north has proved a fairly continuous run of values for about 670 ft. and this ore appears to have been located on Nos. 2 and 4 levels. This work is held to indicate about 100,000 tons of " highly probable " ore, which, added to the reserves at the end of the previous year, gives a total of 290,000 tons of highly probable ore assaying 10·5 dwt. per ton. Later advice, contained in a progress report issued early this month, shows that No. 4 shaft is now equipped for hauling purposes, while 30 ft. of reef exposed on No. 4 level showed the first 25 ft. to assay 23 dwt. per ton. The new plant is said to be operating satisfactorily.

At an extraordinary meeting of the Anfargah Gold Mines and Finance held last month the resolutions involving the voluntary winding up of the company and the distribution of its assets were approved.

Shareholders of Ariston Gold Mines (1929) were informed last month that the concreting of the Alpha shaft in the Anfargah section had been completed and timbering to the lower levels was in hand.

It was announced last month that the Central Wassau Gold Mines had increased its capital to £150,000 by the creation of 500,000 2s. ordinary shares.

Kenya.—A progress report has been issued by Sir Robert Williams and Co. covering work on the Eldoret Mining Syndicate's properties on the Kakamega goldfield. The work of investigation has been in progress since April, 1932, and has involved the detailed examination of a large number of properties covering a considerable area. Up to the present no mining work has been done below water level, diamond drills being used for the deeper exploration. Results to date are held to be so promising that the option over the syndicate's properties has been extended for a further year, to the end of April, 1934. As a result of the application of Tanganyika Concessions, Ltd., for an exclusive prospecting licence over about 5,900 square miles of Kavirondo Territory, the company has been offered rights over one of three areas and will probably select one of 1,550 square miles in which gold is known to occur and where there are held to be distinct possibilities of extensive dredging areas.

Australia.—The Mines Department of Western Australia announced last month that the Western Mining Corporation had undertaken to prospect aerially, geophysically, and otherwise until it has located definite areas worthy of closer investigation. Should such discoveries be made the company will be granted concessions.

A statement issued by the Great Boulder Proprietary Mines, Ltd., last month announced that a provisional offer for the

purchase of the company's properties by the Lake View and Star company had been refused.

New Guinea.—The report of New Guinea Goldfields, Ltd., for the year to September 30 last shows that a modified flow-sheet for the Golden Ridges plant promises good results and sufficient additional cyanide tanks have been ordered to enable 4,500 tons of ore to be treated monthly. Until these are installed the plant is expected to treat about 1,100 tons monthly at an estimated profit of £7,000. Development on the Edie lodes continues to show favourable results, while the report of the consulting engineers states that the alluvial leases worked since February, 1932, had yielded a working profit of £84,906 (Australian currency).

Korea.—Shareholders of the Chosen Corporation, Ltd., were informed last month that the ore reserves of the Great Nurupi mine were 123,000 tons, averaging 6·16 dwt., as compared with 101,958 tons, averaging 6·35 dwt., at March 31, 1932. In addition there were 22,000 tons assaying 3 dwt. in value, which will be payable under present conditions. Ten additional stamps are to be brought into operation at the mill. On the East Nurupi mine there were estimated to be 5,000 tons of ore, assaying 5·5 dwt. per ton.

Brazil.—The directors of the Itabira Iron Ore Company propose to reduce the capital from £2,000,000 to £650,000 by writing off 18s. of each ordinary share and to consolidate the new 2s. shares into £1 shares, while the preference arrears are to be cancelled and the shares to become ordinary shares. After the reduction has been approved the capital will be restored to £2,000,000. It is proposed to issue 63,500 of the 100,000 7% new preference shares which are to be created.

Spain.—The accounts of the Rio Tinto Company for 1932 show a trading profit of £376,293. After making allowances for administration costs, interest, and other items and adding sundry credits there was a credit balance of £58,515, which added to the sum brought in gave an available total of £461,818. Preference dividends absorbed £81,250, leaving £380,568 to be carried forward.

Yugoslavia.—The report of Trepca Mines, Ltd., for the three months to March 31 last shows that 132,436 tons of ore was treated, producing 14,247 tons of lead concentrates and 20,162 tons of zinc concentrates. The estimated revenue for the quarter was £147,992 and the working cost £91,957.

Cornwall.—The report of Tehidy Minerals, Ltd., for 1932 shows a profit of £5,974, increasing the credit balance brought in to £10,983. A dividend of 4½d. per share absorbed £5,513, leaving £5,470 to be carried forward.

Central Mining and Investment Corporation.—The accounts of the Central Mining and Investment Corporation, Ltd., for 1932 show a profit of £515,598, as compared with £445,553 for the previous year, which added to the sum brought in gave an available total of £644,418. A dividend of 12s. per share, against 6s. for 1931, will absorb £255,000, while £200,901 has been transferred to reserve. After making other allowances, there was a balance of £168,972 to be carried forward.

Anglo American Corporation of South Africa.—The report of the Anglo American Corporation of South Africa for 1932 shows a profit of £120,324, which added to the sum brought in gave a total of £218,922. After making allowances for taxation, £218,302 was carried forward. The company's revenue, although showing an improvement over that of the previous year, continues to reflect the depression in the diamond and base-metal industries.

London Tin Corporation.—For the year to September 30, 1932, the net income of the London Tin Corporation was £104,847, against £47,082 in the previous year. After making various allowances the sum of £44,050 was transferred to the appropriation account, which now stands at £180,579. This sum has been carried forward.

Tanganyika Concessions.—At an extraordinary meeting of Tanganyika Concessions, Ltd., to be held this month, it will be proposed that the capital of the company be increased to £10,000,000 by the creation of 4,500,000 £1 shares and holders of Benguela Railway debentures are to be asked to exchange for shares in Tanganyika Concessions.

Copper.—At a meeting convened in London this month by Rhodesian and Canadian producers, at which Mr. A. Chester Beatty took the chair, it was decided to form a Copper Development Association. The new association will have offices in London and will have as its object the collection and dissemination of technical and other information.

NEW GUINEA

By ARTHUR DICKINSON, A.R.S.M., M.I.M.M.

The author, who has been closely connected with the development of the goldfields of New Guinea, gives a description of the properties held by New Guinea Goldfields, Ltd.

INTRODUCTION.—The writer visited the Mandated Territory of New Guinea in 1928 and spent several months on the field and has been able to follow closely the developments since that date. This new goldfield of the Empire is not only of interest on account of the important production that can now be confidently anticipated, but also on account of the nature of the occurrences, methods of mining and transport, and the conditions peculiar to the field.

TOPOGRAPHY.—New Guinea, which is the second largest island in the world, lies to the north of Australia (Fig. 1). The

FIG. 1.—SKETCH MAP SHOWING POSITION OF NEW GUINEA.

At the time of the writer's visit beyond some alluvial work being carried on in the beds of the Edie and Merri Creeks and in sections of the upper Bulolo as well as some development work at the Day Dawn mine there was little or no mining and prospecting work. The change that has been brought about in four to five years is remarkable, especially when one considers the position of the field and the great difficulties that had to be encountered. At present a staff of over 100 white men and more than 1,000 natives is employed and an established gold-mining industry has come into existence. This achievement, under the conditions that prevailed at the outset and with difficulties always to be expected in developing entirely new and remote country in the tropics, has been brought about by an efficient staff under the management of Major G. A. Harrison.

western section is under Dutch government, while the southern section of the remainder is British New Guinea or Papua and the northern section, including the island of New Ireland, is now administered under a Mandate to Australia from the League of Nations. Rabaul, the capital of the Mandated Territory, is situated on New Ireland. Fig. 1 shows the position of the goldfield in the Mandated Territory and Fig. 2 is a map showing the field in its relation to the ports.

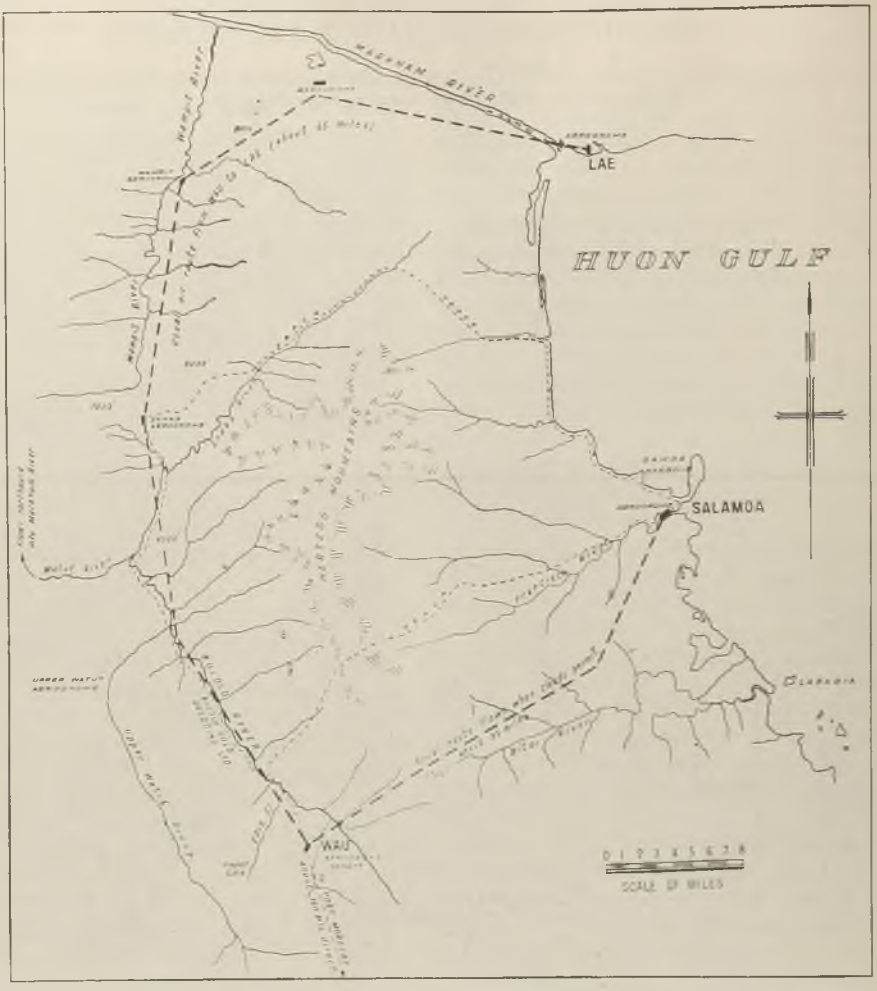


FIG. 2.—SKETCH MAP SHOWING THE GOLDFIELD IN RELATION TO THE PORTS AND AIR-ROUTES.

Salamoa is the seaport of the field. It is a well-protected harbour formed by a narrow, flat tongue of land in parts little over 100 yards wide, but curving northwards to form the harbour and rising to a rocky bluff. Below this bluff there is sufficient depth of water for ocean-going steamers to berth close up to the cliff side and soundings have been made with a view to the possible construction of a wharf at a later date. Between Salamoa and Lae—at the mouth of the Markham River and the site of the aerodrome used by Guinea Airways—is a stretch of 16 miles of coast line, the land westwards from the coast rising through foot-hills to a mountain range 7,000 to 10,000 ft. above sea-level. The country falls again towards the Bulolo River and the Wau, the aerodrome at the latter place being at an altitude of 3,600 ft. The country lying between the coast and the field is rugged and broken, with continuous rises and falls, in parts covered by dense tropical vegetation—occasionally belts of magnificent pines—and in parts large areas covered by a coarse grass (Kunai) that grows to a height of over 2 ft. It is a difficult country to traverse and although there is less than 40 miles in a direct line from Salamoa to Wau the early prospectors did well to complete the journey on foot in a week.

At the Upper Edie—the highest part of the field, which lies at about 6,000 to 7,000 ft. above sea-level—there are various streams and creeks traversing the country, which is hilly in character, the river beds running at times in narrow gorges and at

others opening out into flat sections of river gravel. Of these streams the Edie and Merri are the most important and these join to form the Lower Edie Stream, which, about a mile and a half below the junction, falls precipitously for some hundreds of feet before traversing the lower, more gently-sloping country on its course to the Bulolo. There are various other streams traversing the field, all falling from the high ground of the Edie (so-called) Plateau and eventually joining the Bulolo, which joins the Watut River and finally the Markham River. The country generally is well watered and timbered and the Wau and Bulolo districts are suitable for vegetables and fruit.

alluvial gold were made—and afterwards up to the Edie and Merri Creeks. The values were so good that more and more were attracted by the reports of the fortunes being made and in a short while there was a rush to the field and claims were pegged out all along the Koranga, Bulolo, Edie, and Merri Rivers and intense activity prevailed. The difficulties were enormous, for all goods had to be carried by natives from the coast, labour was scarce and inefficient, and the native tribes between the coast and the field were none too friendly. The administration used their best endeavours to assist matters and introduced regulations by which anyone intending to

Fig. 3.—Wau and Bulolo Valley, 1930.

Climate.—On the coast the climate is tropical and in places there is a good deal of malaria and blackwater fever, but at 3,500 ft. above sea-level one is safe from malarial mosquitoes and the climate on the property operated by New Guinea Goldfields is very suitable for white men. The days are not too uncomfortably hot and the writer found that even at the Wau two blankets were necessary at night and at least four when up at Edie. There is a fair rainfall and mountain storms are frequent.

History.—The existence of gold had been known for some years before the British occupation, but it was not until after the War that Australian prospectors made their way through, first to the Koranga Stream —where phenomenally rich discoveries of

proceed to the field was required to deposit a sum of £50 against possible breakdown and to be inoculated against para-typhoid. In spite of this and of the fact that many of the claimholders were making big profits, there was much distress and sickness amongst both prospectors and natives. With the introduction of capital and the formation of Australian companies to work the alluvial in the upper area and also at Bulolo conditions improved and the advent of the aeroplanes, making transport and communication relatively easy, had an important effect on the position. The New Guinea Goldfields, Ltd., in taking over the operating companies as well as the various claimholders and acquiring further leases to consolidate the position opened up the possibility of developing a sound

Fig. 4.—Road Location, Bitoi Water.

gold-mining business. The result of five years' work has justified their operation. It was obvious from the outset that under the conditions prevailing the matter had to be handled on a comprehensive scale and that prospects warranted such action.

Labour.—The labour on the field consists entirely of natives recruited from the Mandated Territory and the adjoining islands. The quality varies greatly with the different tribes and, although no doubt less efficient than Asiatic labour, it is decidedly cheaper and good results may be obtained from boys of certain tribes, but much depends, as is always the case with native labour, on the efficiency of the white supervisor and his quality in handling natives. Recruiting was none too easy at first, for the field had in the early days earned an unenviable reputation. The enormous difficulties under which work was carried on before the advent of aeroplanes resulted too often in shortage of food and other trials, but at the present time the native worker is well housed and cared for and the change in physical fitness after some months on the field is most marked. Until recently an indenture of two years only was permitted for mining work; the increase to three years—bringing mining in this respect into the same category as for other work in New Guinea—although long overdue, is very welcome and must have an important effect. The labour ordinance includes a definite ration of provisions—rice, meat, vegetables, etc.—for the native and in the early days the cost of a boy—including the recruiting fee—was over £100 per annum. At present, with the considerable reduction in freight charges and the growing of vegetables on the spot, the cost per boy has been reduced to about £45 per annum, or about 3s. per day, all inclusive.

Geology and Gold Occurrences.—The area held by the company comprises about 20 square miles of territory and Tertiary rocks predominate on the surface, volcanic action with subsequent violent denudation having played an important part in the distribution of the gold. For the most part the country is covered by dense vegetation, with moss and roots and undergrowth, making geological investigation difficult, but bedrock is exposed in many of the streams flowing from the higher plateau at Edie Creek towards the Bulolo and the actual mining work on the veins near Edie Creek and at the Ridges has been of material assistance in enabling certain definite conclusions to be arrived at.

In opening up a new field in unexplored country the importance of close geological

Fig. 5.—View at Koranga Creek.

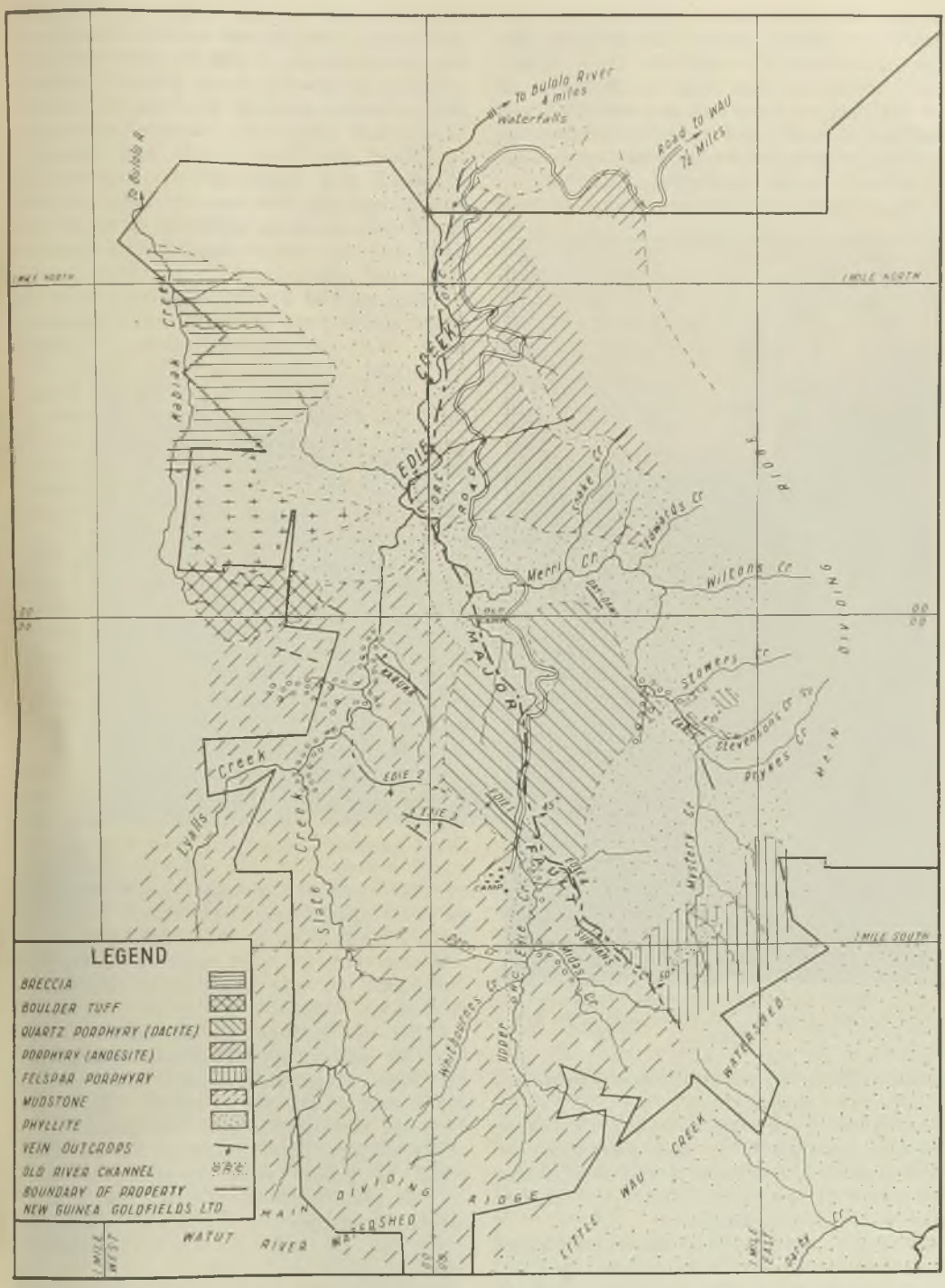


FIG. 6.—SKETCH GEOLOGICAL MAP OF THE NEW GUINEA GOLDFIELDS' PROPERTY.

investigation is obvious and the company has been indeed fortunate in the man who has carried out this work. Mr. H. M. Kingsbury has spent three years on the field and on outlying territory and as a result of most meticulous work and sound reasoning has arrived at conclusions of vital importance in regard to the geology.

There are three distinct types of gold

FIG. 7.—VIEW AT BULOLO, SHOWING PINE COUNTRY. CLIFF ON RIGHT SHOWS LEVEL OF A GOLD-BEARING TERRACE.

occurrence on the field, which it is proposed to describe separately—

(*a*) Alluvial gold was found at the higher altitude principally in and adjoining the Edie and Merri Creeks, as well as in and near the rivers at the lower altitude, principally the Koranga and Bulolo.

(*b*) An occurrence in a flat-lying, clayey, quartzose breccia at the Ridges.

(*c*) Gold-bearing veins at present confined to the Upper Edie district.

Fig. 6 shows the relative position of the places referred to.

(*a*) *Alluvial Gold.*—The gold-bearing regions of New Guinea, both in Papua and in the Mandated Territory, have attained prominence chiefly from alluvial deposits from which practically all the gold production to date has come. The production from the Edie and Merri Creeks and from the Koranga and Upper Bulolo amounts to over £1,000,000 and on the Lower Bulolo the Bulolo dredging company is at present operating with two dredges on long stretches of alluvial ground, which has been proved by most careful drilling to carry £4,000,000 in gold values, and the dredges now operating have been recovering nearly 30 cents (American currency) per cubic yard. The gold is not confined to the present stream beds, but also occurs in old river channels of probably inter- or post-glacial age. This is well shown in the Edie and Koranga sections, where gold-bearing gravels are being worked outside the course of the present comparatively small streams.

The alluvial gold contains about 40% of coarse or so-called "specimen" gold and the fineness of the bullion steadily improves in descending from the gravels of the Upper Edie to those on the Bulolo.

Although the source of the alluvial gold in the Edie Creek area can be partly accounted for by the fact that a few minute stringers have been discovered—chiefly near the Midas Stream—and also by the "specimen" gold found in the Day Dawn deposit, near the junction of Edie and Merri Creeks, nothing has been located that could account for the alluvial gold both in the lower or Koranga-Namie area and in the Upper Edie Creek area. It is also quite evident that the bulk of the gold could not have come from the veins that have been developed, for the character of the metal is entirely different.

As it was possible for geological reasons that the alluvial gold had been transported by glacial action from a main source in the mountainous country forming the divide between the British and Mandated Territories, prospecting was carried out to determine this point. As a result of this work it has been determined that, in lack of definitely supporting evidence, glaciation need not be regarded as an important factor.

Mr. Kingsbury states that in the search for a vein source of the alluvial gold the geological features can be simplified by considering the effects of volcanic activity

and the accompanying period of rapid denudation, when the alluvial gold was first being transported and laid down with the great mass of material swept down from the hills to be later reconcentrated in the present-day creeks and rivers, and he is confident that the alluvial gold has been derived from local sources. He thinks it probable that it represents the concentration from the denudation of large blocks of country and small stringers carrying gold, now entirely swept away. The endeavour to locate the vein source of the gold is complicated by the fact that the present alluvial represents—especially in the Koranga-Namie area—a second concentration and has been derived from the mass of debris swept down in a previous epoch of rapid denudation.

Although the river beds of the creeks are narrow and tortuous and boulders exist in some quantity, sluicing is still being carried on with profit in the river beds and in terraces adjoining the creeks. In addition, exploratory work on the old river channel in the Upper Edie shows satisfactory gold content and opens up further possibilities, while there are also large areas of considerable promise in the neighbourhood of the Koranga and Bulolo. Sluicing is being carried on in parts by means of "boxing" and on some sections hydraulic elevating is being employed. Taking the three months November–January of this year the output averages £9,000 Australian currency per month.

(*b*) *Golden Ridges.*—The ore in this deposit can be described as a clayey, quartzose breccia, with manganese oxides present. The ore-body is flat and has a thickness of approximately 20 to 25 ft. and covers an area of about 300,000 sq. ft. The average grade has been proved by careful pitting and sampling—gold 1·145 oz., silver 4·61 oz. per ton. The ore-body is overlain by a sill-like mass of quartz-porphyry and above this a mudstone, the alteration product of a volcanic breccia. The depth of this overburden varies, but it probably averages 20 to 30 ft. It can be easily and cheaply removed by drag-scraping and sluicing.

Fig. 8.—Sluicing overburden at Golden Ridges.

A small mill and cyanide plant has been erected to treat this ore and is now being enlarged to treat 4,500 tons monthly.

(*c*) *Gold-Bearing Veins.*—(1) The Upper Edie Creek District.—This district forms an elevated, cup-like region, about three miles in diameter, enclosed within high hills (Fig. 6). The geology of the plateau region is simplified by grouping the various rock formations into four categories—

(i) Dark-coloured shales, slates, and schists, comprising the basal complex of New Guinea.

(ii) Mudstone, a yellowish-brown, bedded formation of undetermined age, which for at least a few hundred feet below the surface is a soft, but fairly firm rock, into which cuttings can be readily made without use of explosives.

(iii) Volcanics such as explosive breccias, similar to the rock enclosing the ore occurrence at the Golden Ridges.

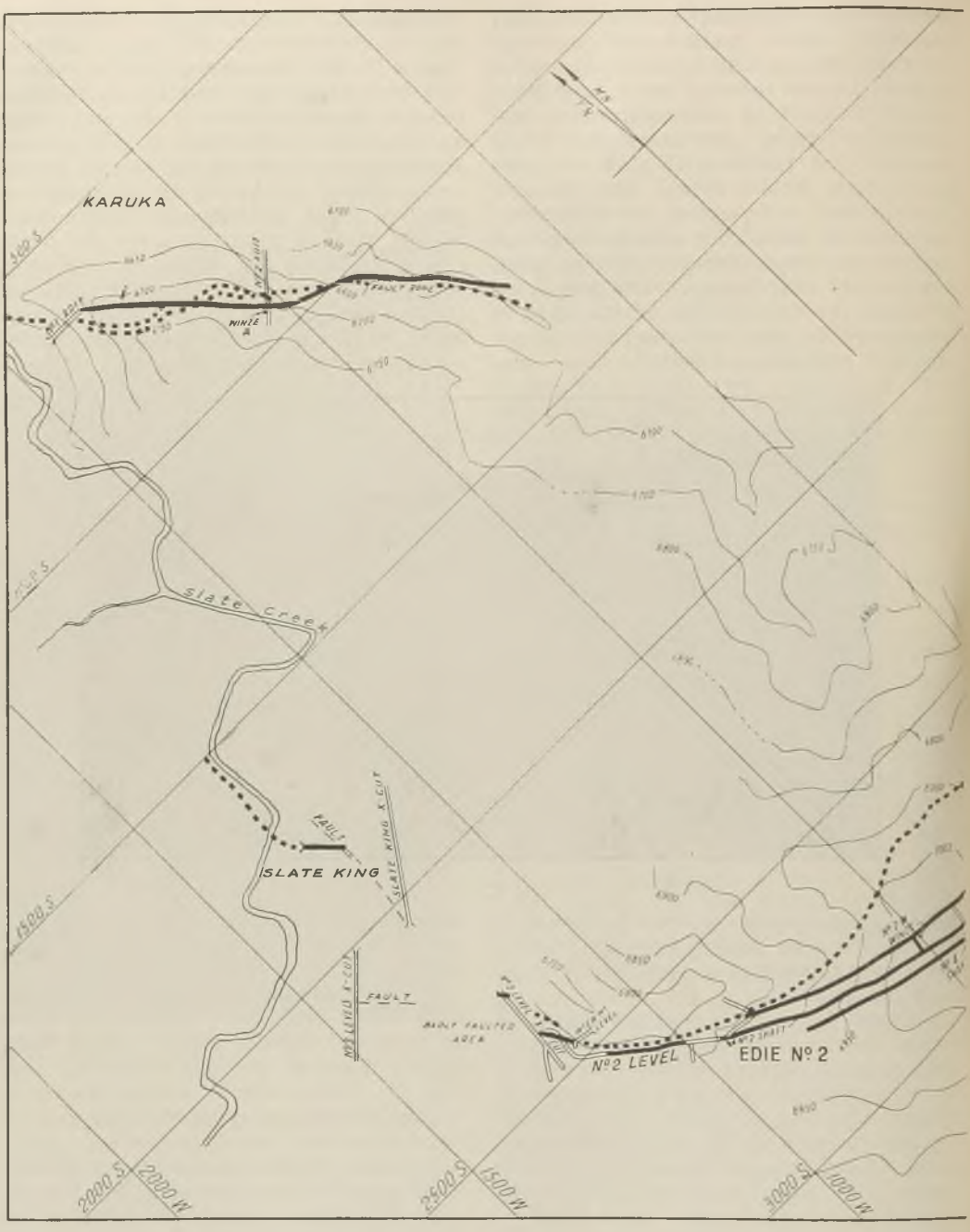
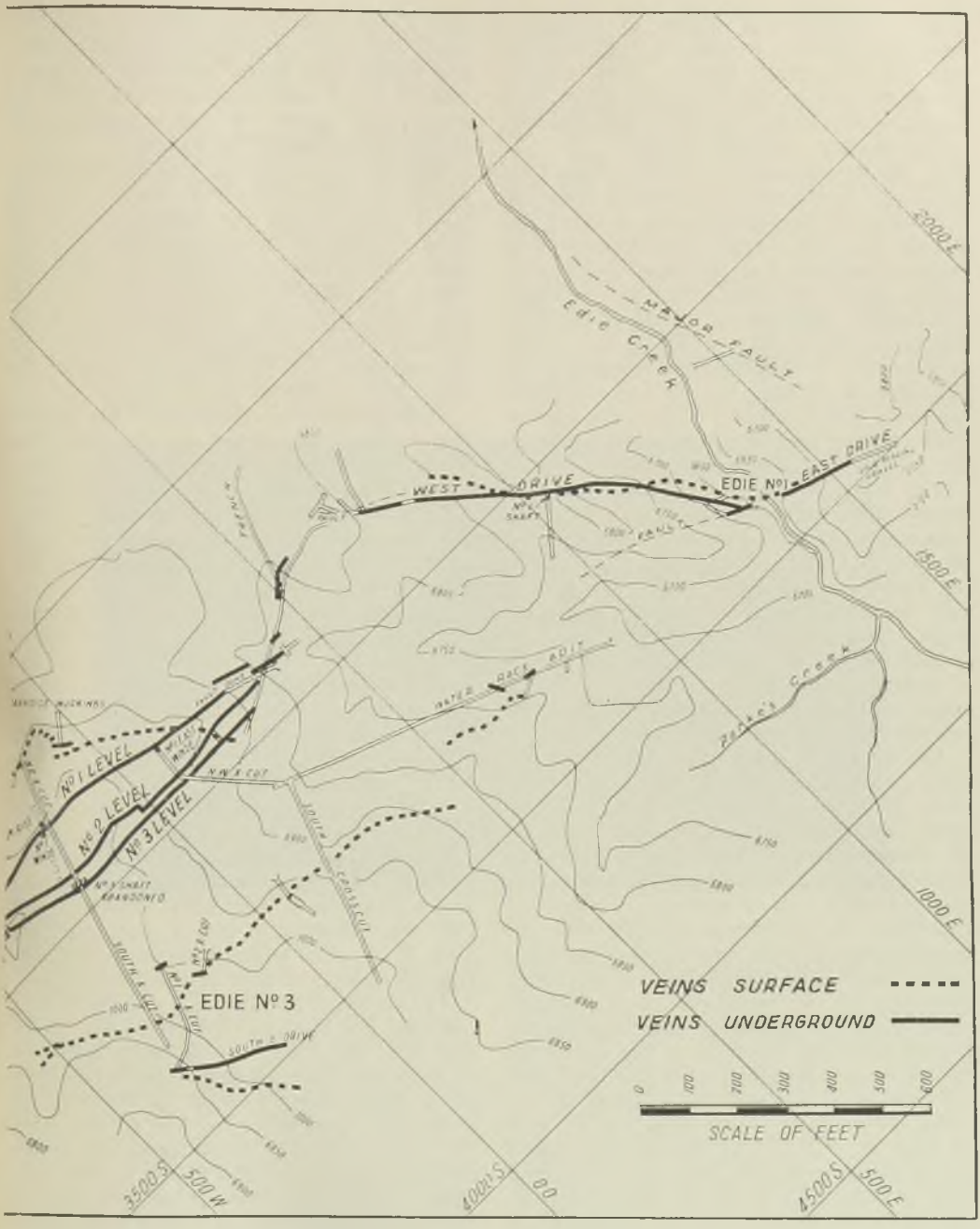


FIG. 9.—PLAN OF THE PRINCIPAL

(iv) Quartz-porphyry intimately associated with the mineral occurrences in the lower region.

The geological structure of this district is complicated, but in general the distribution of the various rock formations is confined chiefly to three rather well-defined areas running north and south.

The older formations comprising the basal complex series make up the eastern section, which includes the Mystery and Merri Creeks and, therefore, several



Workings on Edie Creek.

occurrences such as the Day Dawn, and all these are in shale, slate, or schist, with quartz-porphyry in every case in the immediate vicinity. The central section and much of the southern part of the western section is comprised of mudstone. It is the country rock of the principal veins now being developed, except No. 1 and the White Lode at No. 4, both of which are in quartz-porphyry, which has invaded the mudstone.

The volcanic series are widespread over the northern half of the western part of the

district, indicating a centre of vulcanism somewhat similar to one in the Koranga area in the lower region. The quartz-porphyry has intruded shales, schist, and slates, as well as the mudstone and volcanic areas, in a very irregular manner.

A strong structural feature, known as the Major Fault, provides a line of demarcation between the eastern area of slates and schists and the central mudstone section. It would appear that this fault is an overthrust, with the eastern section overriding the central, and that the course of the Edie has been largely determined by it. Where encountered in underground workings the fault has in no case been found to cut off the veins and it appears to be a pre-mineral fault, with a possible important bearing on the localization of mineralization.

The rock adjoining the veins as a rule shows no alteration, being identical in appearance to the same rock remote from mineral occurrences. The principal mineral occurrences in the Edie Plateau are typical vein deposits, with generally sharply-defined walls. The general trend of mineralization is N.W.–S.E., but some of the veins have a nearly E.–W. strike. In general the veins are persistent without a break for several hundred feet.

The mudstone (an altered product of the slate or schist) in which most of the veins occur is an outstanding feature and is in every case closely associated with intrusions of quartz-porphyry and this is true not only of this area, but also of the lower area at the Ridges. Mr. Kingsbury is convinced that there is evidence suggesting that the quartz-porphyry, the forerunner of mineralization, has largely contributed to the change from phyllite to mudstone by emanations rising from this intrusion and in this connexion he draws attention to the stockwork nature of the mudstone with fine veins and stringers occurring every few inches and at times with veins of important width, such as Edie No. 2 vein and others. He points to the similar geological conditions obtaining at Edie Creek and at the Golden Ridges and inclines to the opinion that the alteration is not due to weathering, but may be found, as has been proved at the Ridges, to likewise overlie porphyry and ore and the mudstone alteration due to emanations coming directly from the quartz-porphyry. The mudstone alteration has in his opinion a decidedly important significance in terms of ore, for it would mean that the quartz-porphyry at Edie Creek spreads out under the mudstone areas and if it spreads out sill fashion as at the Ridges this would introduce structural control and a concentration of ore under the impervious barrier of quartz-porphyry as clearly illustrated at the Ridges.

The veins are typical vein deposits with generally sharply-defined walls. Quartz and oxides of iron and manganese are the principal gangue constituents and in many places the veins consist almost wholly of sandy or rubbly quartz. Mineralization has been definitely established as being Tertiary and of epithermal origin. Its general trend is N.W.–S.E., but some of the veins have a nearly E.–W. strike.

Underground developments have shown that faulting has played an important rôle in the localization of mineralization. Several veins shown in Fig. 3 have been developed from adit levels and long distances driven. Fig. 4 is a plan showing development work on Edie Veins Nos. 1, 2, and 3 and the Karuka Vein.

On Edie No. 1 west drive the average value for 750 ft. is 20 dwt. gold and 26 oz. silver per ton over a width of 41 in.; on Edie No. 2 No. 1 level averaged for 1,100 ft. 11 dwt. gold and 28 oz. silver per ton over a width of 53 in. and No. 2 level for 910 ft. 9·1 dwt. gold and 15·3 oz. silver per ton for a width of 40 in.

With the installation of power steps were at once taken to prove the veins in depth and Shaft No. 1 on Edie Vein 1 has been sunk to a depth of 200 ft. below adit level and a cross-cut is now being driven to cut the vein. Sinking of No. 4 shaft on Edie Vein 2 is also being continued and has reached a depth of over 400 ft. from surface.

Transport.—In spite of the fact that the field lies less than 40 miles in a direct line from the coast, the difficulty and cost of transport have been factors of considerable importance. Goods on arrival at Salamaua have to be landed at the jetty and then taken 16 miles along the coast in motor-boats to Lae, where Guinea Airways, Ltd.—the pioneer flying company on the field—have their aerodrome and equipment. In 1928 the charge was 1s. per lb. for all goods transported from the coast to the Wau aerodrome. The writer succeeded before he left the field in reducing the price to 9d. per lb., but even at that figure it seemed obvious that New Guinea Goldfields would make a considerable saving by arranging for their own freight with

their own air service and at the same time organizing a flying service from Salamaua and so avoid the extra freight and manhandling required in using Lae as an airport.

An aerodrome was made just to the west of Salamoa and a Handley-Page machine was sent out in 1929 under the control of Imperial Airways. Major Thomson—the pilot in charge—did excellent work between Salamoa and Wau for a period of several months, but finally crashed en route to the field, fortunately without loss of life, but with total loss of the aeroplane. The price for freight charged by Guinea Airways had in the meanwhile been considerably reduced and an arrangement was made with that company for transport to the field. They have carried out the work very efficiently and the present charge is 4d. per lb. as an all-round rate from the coast. The air distance is 65 to 70 miles and in good weather planes make three trips a day, the largest machine being capable of carrying parts of over three tons in weight. This new goldfield in New Guinea affords one of the most striking instances of the development of commercial aviation. On the New Guinea Goldfields property there will be about 1,500 people resident and all supplies for this population, as well as machinery, tools, and stores, are brought by plane. In addition the two large dredges operated by the Bulolo dredging company have been brought in by plane from Lae.

The question of transport from the coast has been very carefully considered with a view to an eventual reduction in cost per lb. carried either by a light mineral railway or by a road with use of tractors. Surveys have been made and estimates of cost furnished. The initial cost of a railway would have been very great and the length over 100 miles, while not only would construction have been difficult, but the cost of maintenance would have been excessive. Over large sections the country is subject to slips and wash aways on the steep hillsides, in spite of careful contouring, would have been frequent. The same difficulties and heavy maintenance expenditure would apply in the case of a road.

The construction of a road is, in the writer's opinion, really a matter for the Government to consider. The early pioneers and the companies now operating on the field have done more than their part in opening up a new district and in proving its value and the Administration might well be expected to undertake the construction of a road, which would not only be of material assistance, but would also constitute an important step in the further development of this section of the Mandated Territory.

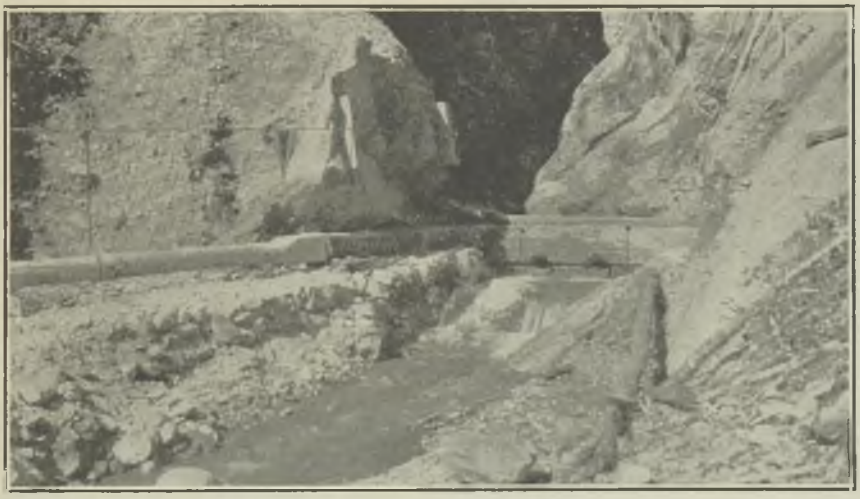


Fig. 10.—Dam on Kunai Creek.

Communication with Australia is by steamer once in three weeks from Sydney or Brisbane. These steamers make a circular route *viâ* the capital Rabaul before arriving at Salamoa and the journey takes about two weeks. An air mail is now in operation from the field to Port Moresby, the capital of Papua, from which port communication

with Cairns, in Queensland, is rapid and frequent. Telegraphic communication is easy and ever since 1927 it has been possible to send wireless messages from Edie Creek.

POWER.—A power plant to generate 400 h.p. was installed in 1931 at the Wau. It consists of two Sissons water-tube marine-type boilers for wood fuel consumption, a 300 k.w. turbo-alternator, turbines, condensing plant, etc., with transmission lines to Golden Ridges and to Edie.

MINING LAW, TAXES, ETC.—A new mining ordinance, with mining regulations, was issued by the Administration in 1928. This ordinance is based on the Queensland

FIG. 11.—MONITOR WORKING ON THE BULOLO.

mining law, but is framed to meet the conditions obtaining in New Guinea. There is a warden on the field and matters affecting the law or tenure can generally be settled fairly promptly. The native labour ordinance—designed primarily to safeguard the interests of the natives—deals with housing, care, and food as well as hospital treatment, with proper medical supervision.

Taxes.—A royalty of 5% on the gross value of the gold is charged by the Administration. Some seven to eight years ago the royalty was only 1%. At that time there was much dissatisfaction on account of very ineffective police supervision, resulting in frequent desertions of boys on contract without any redress, and the miners generally felt that the Administration was not giving them sufficient assistance. When the Administration stated that they could do no more and that the field was expected to defray all costs of Administration out of royalty the miners suggested that this might be slightly increased to meet the objection and to increase efficiency. To the dismay of the miners the Administration promptly increased the royalty to 5%. At the present time this figure would appear to be altogether excessive and the Administration will no doubt honour their promise to consider favourably a reduction as soon as the mines reached the producing stage. British machinery is admitted into the territory free of tax.

Miners' rights are issued by the Administrator for a period of years not exceeding 10, upon payment of a sum of £1 yearly.

Mining Leases are provided for under the ordinance as follows :—

Gold Mining Lease.—Not exceeding 21 years, but renewable, the area not to exceed 20 hectares. Rental, £2 10s. per hectare and subject to a provision for employment of labour of a specified amount. If the Administration is satisfied that greater facilities for the working of two or more contiguous mining leases would be ensured by the union of those leases such union may be authorized on conditions.

Mineral Lease for any mineral other than gold.—Not exceeding 21 years, but renewable, the area not to exceed 100 hectares. Rental, 25s. per hectare and subject to a provision for employment of labour of a specified amount.

Gold Alluvial and Puddling Claims may be granted to holders of miners' rights. An ordinary gold alluvial claim is defined by a frontage of 120 metres in the general direction of the course of the stream, with a width from bank to bank limited to 100 metres, and not more than 10 such claims may be taken up conjointly. The extent allowed for puddling claims is double that for alluvial claims and such claims shall be as nearly rectangular as possible, with no side less than 30 metres in length.

Prospecting Claims.—Provision is made under the ordinance for granting prospecting claims in the event of the discovery of a new reef or new alluvial ground and these claims are additional to the number of ordinary claims to which the holders of mining rights would be entitled.

Dredging claims will only be granted—

(*a*) When the ground applied for has previously been worked and abandoned.

(*b*) When the known poverty of the ground warrants it.

(*c*) When the ground is only suitable for dredging on account of its excessive wetness or on account of the costliness of the appliances required to work it.

The area comprised in a dredging claim shall not exceed 200 hectares and the length of the claim along the foreshore shall not exceed 10 kilometres. The rental is 6s. 3d. per hectare for the first year and 12s. 6d. per hectare thereafter.

GENERATION OF POWER AT THE LAKE VIEW AND STAR MINE

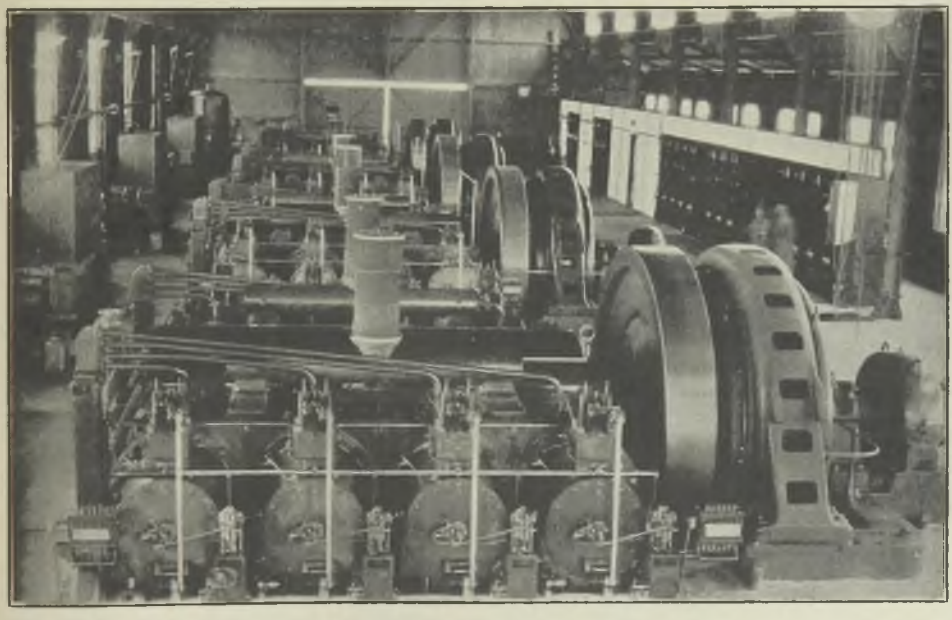
By W. R. DEGENHARDT, M.I.M.M.

The author makes a comparison between the cost of power as now produced and as previously purchased.

For many years the Lake View and Star, Ltd., in common with many other companies, has purchased electric power from a local power-supply company for purposes of compressed-air supply for underground and for ore treatment on the surface, both departments calling for a considerable quantity of power. The figure commonly paid was in the vicinity of 1·59d. per unit, which, reflecting on the costs per ton of ore treated, amounted to approximately 3s. 10d. per ton.

The gradual increase in power requirements for the Lake View and Star mine, due to the greater quantities of ore made available through amalgamation of certain leases, called for more power than was obtainable from the supply company previously mentioned and, with a programme of expansion which to-day has resulted in an output of over 40,000 tons of ore per month, provision for power had to be thought out and arranged at least 18 months to two years prior to its being called on for constant use.

At this period of initial planning a proposition was considered whereby the supply company might continue to provide the necessary power, but, on account of their decision to adhere to wood-fuel steam-raising and turbo-generators, together with the fact that a separate organization supplying power had to provide not only for amortization and interest on capital expended but a reasonable



Crossley-Premier Oil Engines at Lake View and Star Mine.

return in the form of dividends to the shareholders of the supply company, a power cost comparable with that which might be achieved by modern methods of oil-power generation could not be offered.

It was then decided by the directors of the Lake View and Star company that they should build up a modern power plant of their own, using direct-fueled prime movers in the form of Diesel engines, since by this means thermal efficiencies of over 30% were possible as compared with from 10 to 15% when using wood fuel. Extensions to a Diesel plant could be made more economically to meet the exact demands of the mining and treatment expansion, with the result that to-day the mine is equipped with a power plant, illustrated in part in the accompanying figure. This plant comprises four 8-cylinder *vis-à-vis* Crossley-Premier oil engines direct-connected to 620/700 k.w. alternators supplied by the British General Electric Company. These four engines comprise the main plant for electric power generation and operate continuously day and night for 30 days at a stretch. In addition to this plant there are three standard four-cylinder oil engines of the same make direct-connected to Belliss and Morcom 2,000 cu. ft. compressors, the cost of air so supplied being appreciably lower than with either the steam or electrically-driven compressors which they supersede.

The actual costs for power as now produced and as previously purchased are respectively 0·65d. per unit and 1·59d. per unit. In the same way, air compressed to 90 lb. per square inch by means of the direct-connected oil engine sets costs 2d. per 1,000 cu. ft. of free air, which compares with at least 3·5d. with an electrically-operated set using purchased power. This, reflected in mining and treatment costs, represents a total electric power cost to-day of 1s. 7d. per ton, as compared with a figure previously mentioned for purchased power of 3s. 10d., showing a saving of 2s. 3d. per ton treated. This in itself is a most important point, when it is realized what proportion the electric power costs bear to total treatment and mining costs, which to-day are respectively about 6s. 10d. and 15s. per ton.

Included in the advantages of this modern power plant is practical immunity from shut-downs due to electrical storms and tornados. The power plant is situated immediately adjacent to the mill and the electrical portion is free from outside influences such as obtain where a transmission line of some length exists between the source of supply and point of consumption.

The whole of this plant has been erected at the Lake View and Star mine within a period of two years and additional units of 1,000 h.p. continuous rating can be added at will and brought into service within a month or six weeks from the arrival of the machinery on the site.

A further improvement in the power situation has recently been made through the adoption of slight supercharging, whereby the weight of air drawn in the cylinders for combustion and scavenging is increased to slightly more than normal at sea-level in a temperate climate, electrically-driven fans being used for this purpose. The net result is that 10% additional power is obtained under site conditions from the engines, which, in addition to being in no way adversely affected by this increased load, will actually run cooler, a matter of great importance in a climate where temperatures in the Summer rise to as high as 120° F.

It may be of interest to readers to note the following particulars, not only of actual erected costs of the above plant, but, in a summarized form, the present detailed costs of generation in comparison with the power cost prior to the installation of this modern plant :—

Compressed-Air Plant.

Three Crossley-Premier 4-cylinder oil engines delivered at site	£14,457
Three Belliss and Morcom air-compressors delivered at site	6,825
Compressor house building (existing)	—
Foundations, etc.	2,655
Erection, labour, and supervision	5,575
Sterling	£29,512

Electric Power Plant.

Four Crossley-Premier 8-cylinder engines, G.E.C. alternators, switchboard, and auxiliary plant, delivered at site	£70,940
Power house building, erected	3,826
Foundations, etc.	4,822
Plant erection, labour, and supervision	14,241
Sterling	£93,829

Generating Costs (Delivered at Switchboard).

	Pence.
Fuel Oil (at £8 10s. per ton)	0·540
Lubricating Oil	0·003
Cooling water	0·010
Supervision and labour	0·087
Repairs and maintenance	0·010
Australian Currency	0·650 per k.w. hr.
Cost of purchased power	1·59 per k.w. hr.
Saving	0·94 per k.w. hr.

THE APPLICATION OF MECHANICAL EXCAVATORS IN MINING

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

A review of the recent progress and advance in excavator equipment and in the methods of application.

The use of mechanical excavators is not confined entirely to open-cut mines, as is commonly suggested when the question concerning the application of this class of plant in mines is under discussion. Even though the normal home of the excavator is an open-cut proposition they have their uses on many other mines. Every mine, particularly in the early stages of its life, has its earthwork problems—such as, for example, the excavation of foundation pits, levelling plant sites, road and railway work, and the cutting of trenches and building of embankments. Some find use for a small excavator throughout their lives on work incidental to running operations, such as work on roads, canals, dams, removing slag dumps, or on loading ore.

The shovel or dragline is the most versatile of all excavators and under suitable conditions is able to accomplish successfully many of these operations. Special front-end equipment, consisting of different jibs, dipper arms, and buckets, which is interchangeable with any standard machine of one class, has been evolved and this, if used on the job for which it is meant, is designed to execute the work more efficiently and more rapidly. The more exacting demands for greater production and lower costs to-day have been responsible for the rapid evolution of the older type of excavator to a specialized machine, or a convertible machine which can be quickly prepared to tackle a special job with speed and efficiency. So that now, besides having a particular excavator for the work in hand, we have at the same time a machine which can be adapted to suit abnormal conditions, or that can be taken off one class of work and put on another with the minimum of trouble or loss of time.

Besides the more usual operations of stripping overburden and mining and loading ore and the other work previously mentioned, trenches for laying electric cables or pipelines can be rapidly and cheaply cut by an ordinary excavator having specially-designed front-equipment. A view of a machine so fitted, with a section of the trench which it is excavating, is shown in Fig. 1. Loading ore, coal, or coke from stock-piles or wagons is another operation common to many mines and one that may be conveniently executed by means of a grab—a machine fitted with an extra long jib and a clam-shell type bucket. A $1\frac{1}{2}$ cu. yd. grab is shown loading trucks in Fig. 2. This model has also been mounted on a pontoon and used to load alluvial gravels from river deposits in alluvial mining.

A skimmer-scoop comprises another form of front-end equipment which is used to convert the ordinary excavator into a machine capable of tearing up road surfaces or concrete foundations, or, under special circumstances, it may be used to strip shallow overburden. Fig. 3 illustrates a machine so equipped, employed on the first-named work.

By arranging that the different combinations required to convert a machine to any special form can be quickly changed in the field, the standard excavator to-day is universal in its application. Actually, an adapter casting may be obtained for some machines so as to enable any desired front-

FIG. 1.—CONVERTIBLE EXCAVATOR BY THOMAS SMITH USED AS A BACK TRENCHER.

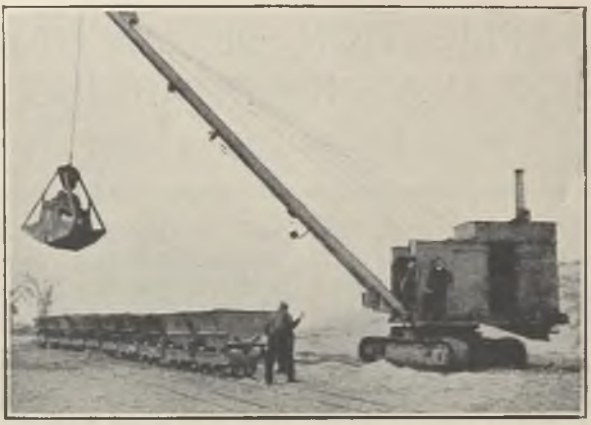


FIG. 2.—1½ CU. YD. GRAB USED FOR LOADING ORE.

end equipment to be fitted should a machine be required on different work. Fig. 4 shows the same machine as illustrated in the previous figure now fitted with the more common shovel front-end equipment, and Fig. 5 a similar machine rigged as a dragline excavator. Other forms which a standard machine of this sort may take are those of a crane or pile driver. The former, mounted on caterpillar traction, is an invaluable unit for every big job. A machine used in this way on mine construction work in the Congo is shown in Fig. 6.

CONDITIONS OF WORKING.—There are really no conditions which tend to limit the use of excavators for general purposes on mining propositions in any way. Convertible machines, having a choice of seven different attachments for as many different classes of

FIG. 3.—RUSTON-BUCYRUS EXCAVATOR FITTED AS A SKIMMER-SCOOP.

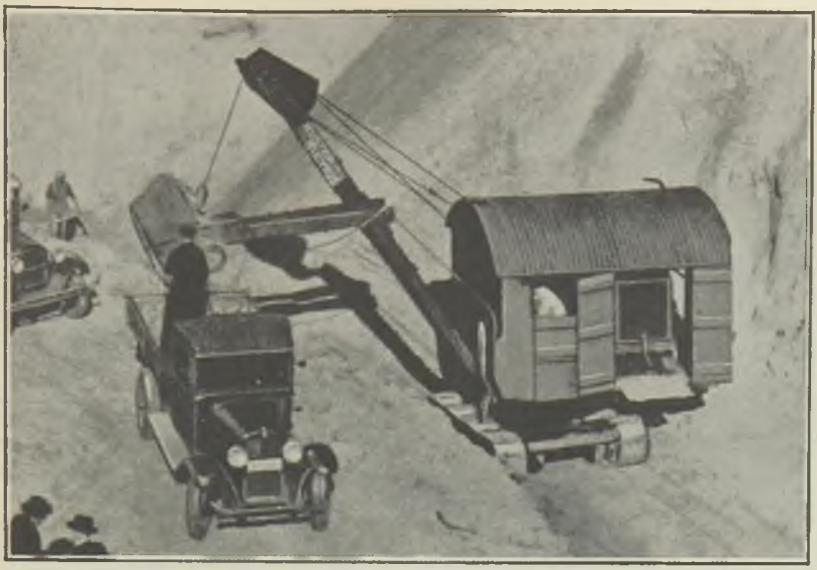


FIG. 4.—RUSTON-BUCYRUS EXCAVATOR WORKING IN CHALK.

work, give a wide range to select from. They are made in a great number of standard sizes, ranging from ½ cu. yd. to 3 cu. yd. bucket capacity, while even the large shovels from this size up to those of 18 cu. yd. bucket capacity may be conveniently converted for dragline work by simply fitting a longer jib and using a smaller bucket. These large machines are built essentially for stripping and loading operations and, where heavy rock mining or quarrying is expected, machines are built of extra robust design to ensure reliability in face of the most severe excavating duty. A 4 cu. yd. heavy duty electric shovel of this sort is shown in Fig. 7.

The smaller-sized excavators of compact design are more in evidence as general utility machines, while their size is often a decided advantage for work in restricted spaces. Also the fact that a good digging reach and dumping height and low centre of gravity are amongst the features incorporated in many small excavators to-day gives these small rugged machines a decided advantage over the large and heavier types when reckoned in terms of output per pound of weight.

The small excavator is not only light in weight, but is built on experience gained over a span of 50 years, resulting in machines of great reliability, factors which are of outstanding importance next to speed and economy of operation. A machine which can be handled easily from one place to another, or travelled without trouble over rough surfaces means a big saving in time and in lost output. This is a decided advantage of the small excavator, which is moved under its own power with no difficulty over the roughest ground, thanks to its comparative lightness and to the present-day practice of fitting caterpillar tractors with a wide tread. No dismantling is necessary when moving a machine to a new place, even if this entails a move of some distance, for it may be loaded on to a lorry

FIG. 5.—MENCK AND HAMBROCK DRAGLINE DIGGING A CANAL.

FIG. 6.—EXCAVATOR FITTED AS CRANE ON A CONGO MINE.

or railroad truck under its own power and transhipped to its new place in this way.

ADVANTAGES OF EXCAVATORS. — The principal advantage to be gained by the use of excavating machinery for digging and loading ground is the lessening of labour troubles, including that of labour shortage, thereby ensuring regular and stabilized production. In some countries the celebration of feast days or other holidays are so frequently the cause of the stoppage of work that machinery is introduced to maintain steady operating conditions and to guard against irregular outputs from this cause. No wonder, then, that in Manchuria they say "the striking contrast between old and new is shown in the sight of steam shovels moving lumps of mountain, while a few yards away you will find men at work with wooden hoes, as in Biblical days." This is not an uncommon aspect of the position. We find it so all over the world. The manufacture to-day of individual basic machines, adaptable for any special work, makes the use of excavators an absolute economic proposition wherever ground must be moved in large quantities. It is the same with regard to costs. Excavators compete successfully with the cheap labour made up of the black or coloured races of the Far East, India, or Africa—possibly because this labour only appears to be cheap. Its inefficiency generally necessitates great numbers and consequently needs more supervision and very often those responsible for its direction are wasteful of it.

The operating efficiency and low upkeep costs of up-to-date machines, which assure even greater outputs at lower costs, result in numerous examples of cheap production by excavators, which compare favourably (under the most exacting conditions) with hand work or any other method of breaking ground and where these machines are producing large outputs in deep ground there is no comparison, for the excavator not only breaks the ground, but stacks it or loads it in wagons in one operation and at one all-in cost. Conditions are often such that it would be practically impossible to mine an ore-body at the same rate or at as low a cost—as for example, when the ground is deep or narrow. For the same reason it is often cheaper to employ excavators to open up a deposit than work it by underground methods and also because the ore-body is of such a shape that the output by

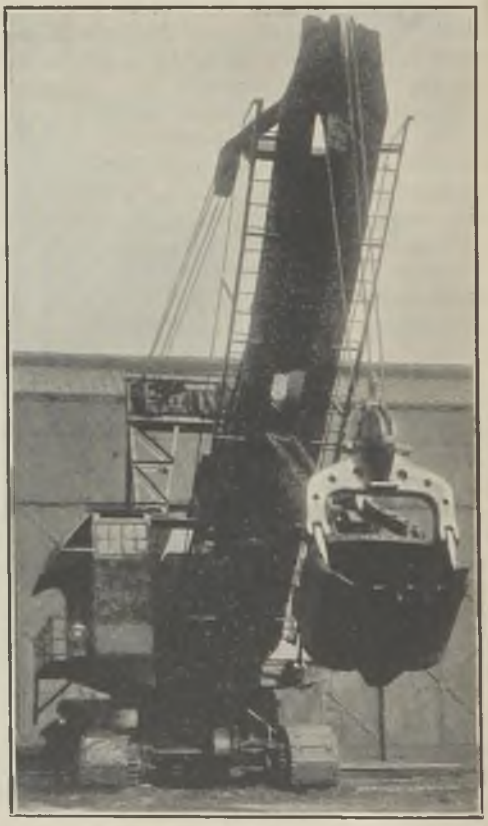


FIG. 7.—4 CU. YD. HEAVY-DUTY SHOVEL BY RANSOMES AND RAPIER.

underground methods would be too small and the costs too high to offset overhead charges.

The satisfactory use of crawler or caterpillar traction during the Great War and the successful development of this since then in place of railroad traction for mechanical excavators has given these machines unequalled mobility, a valuable asset in a self-contained unit of this sort. Both large and small standard machines are fitted with caterpillar traction to-day and in the case of the larger excavators direct saving in working costs has been made possible by the saving in labour and material in track work and the elimination of the pit gang. An indirect economy is also effected by the time saved in travelling the machine up to the face. On the smaller class of machine the chain drive is dispensed with altogether, experience having shown that a drive by means of direct bevel and spur gearing is superior to the old methods. The employment of this principle is illustrated in Fig. 8 on a ½ cu. yd. convertible excavator. In these drives the gear wheels have teeth machine-cut from the solid and the gearing under the lower frame is totally enclosed and runs in an oil bath.

In order to provide even greater mobility and stability for an excavator working on a soft bottom a new oversize caterpillar mounting has been recently developed. This consists of the use of links of 36 in. and 42 in. wide in each caterpillar, making the whole width of the traction about 13 ft. 6 in.

Progress in many details and improvements evolved from earlier practice have all helped to lower excavating costs. The whole trend of shovel and dragline design in the past decade has been towards heavier and bigger capacity machines having increased dumping height and a longer reach, factors in stripping and loading that ensure big outputs, high dumping capacity, and a substantial saving in the width of cuts owing to the advantage in reach as compared with the restricted cutting radius of the old railroad type of shovel. The advantages of the complete circle as compared with the old part-way swing is also an outstanding feature of the new and bigger machines. While all these advantages of the large powered excavators are quickly recognized, its extreme weight (amounting to anything from 300 to over 1,000 tons in one unit) and its comparatively slow movements are factors that must call a halt to this forward march of large-scale construction, or else this big capacity machine will defeat its own ends by allowing its weight to affect its mobility seriously. Even when all auxiliary plant is of a size commensurate with the excavator it requires an exceptional system to keep pace with the enormous output or to avoid delays and

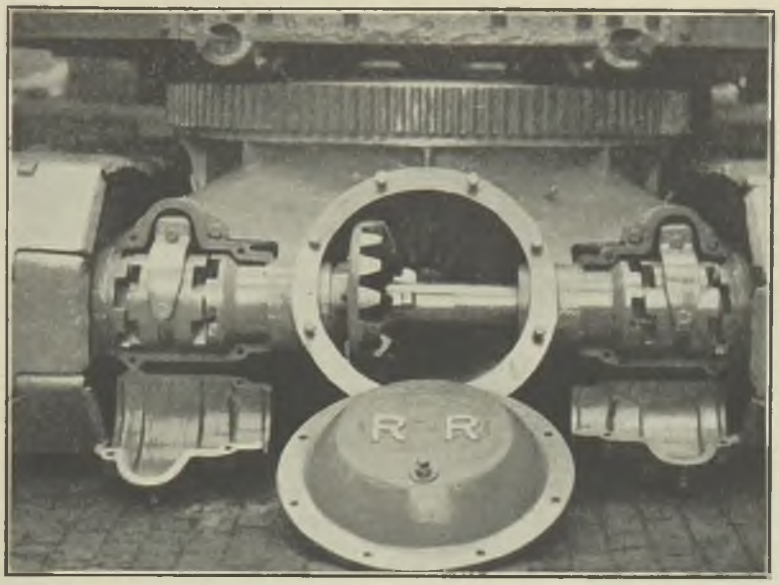


Fig. 8.—Direct-Drive Gear on a small Ransomes and Rapier Excavator.

stoppage of the machine. Large wagons are necessary to permit of moderately fast loading without excessive spillage. A breakdown or delay on a large excavator or on any of its auxiliary plant involves such an enormous tonnage that when working on ore the loss due to the decreased output on most mines is a serious matter and when a company is dependent on one machine for its output the risk entailed is comparable to having all one's eggs in one basket. Even though a large machine is able to yield a large output at a low unit cost it must be remembered that the purchase of such a machine involves a large capital outlay which should be fully justified by the size of the ore-body it is to be employed on. In many cases, where cutting or dumping height is an unimportant consideration, it would probably be more advisable to install two light-weight machines which together would give an output equal to that of a large one.

Mechanics of Excavator Design.—The severe and exacting requirements of excavator duty necessitate perfect design and construction and the inclusion of the best materials in the building of these machines. Built as a result of fifty years of hard experience they have been helped to perfection lately by the enthusiastic support and greater demands of earthworkers and by the development of more extensive methods of working. Scientific and engineering advancement has assisted in the progress made by making available special alloy steels eminently suitable for a machine which is subjected to abnormal strains and stresses and heavy wear and tear. Lighter steel of equal strength reduces "dead-weight" and the swing load, while harder steel cuts repair costs by reducing wear and tear. The extended use of aluminum and duralumin in the construction of large excavators should go a long way towards eliminating the weight factor as a handicap in these machines.

Minor but important wearing parts in excavating machinery are the bucket teeth, the lasting qualities of which depend entirely on the nature of the ground being excavated. Bucket teeth are made in various forms and of either manganese or plain forged steel. A mild form of controversy exists as to which material is the more lasting—that is, whether the steel teeth, by reforging, can be made to outlast those made of the harder steel. As the abrasive action of the ground structure varies considerably within small areas, teeth made of the same material often differ in their lasting qualities, even though they are digging the same ground, but in different machines. On the other hand, the results obtained on both forged steel and manganese teeth used in one neighbourhood or in one class of deposit are so very similar that even the higher cost of the manganese is offset by the expenditure in frequently changing and forging the steel teeth. A new departure in excavator teeth was recently referred to by Hubbell,[1] molybdenum-chrome steel (Westeco-Moly-chrome) being the material used, the teeth made of which are credited by the users with long life in fair digging. These teeth are reversible and can be resharpened. Reversible teeth is one common form of manufacture and is an improvement on the older type of non-reversible teeth, but more recent practice, especially in the larger bucket sets, is to make the tooth in two parts consisting of a base and a point, the latter sometimes being reversible in the base, which is bolted to the bucket bottom. The popular combination of this form is a manganese point fitting into a forged steel base, since the wear on the latter fitting is infinitesimal as compared with that on the former.

Certain firms have introduced cast steel construction for all the main frames of their smaller excavators and now there is a definite trend for this type of construction in all small machines.

Another significant step in mechanical advancement in excavator design is the increased use of ball and roller bearings in present-day machines. This advancement, starting with brass bushings, which were in general use ten years ago, leading to white metal and gun metal as anti-friction surfaces in recent years, is typical of the aim of makers to produce a perfect mechanical job. The introduction of ball and roller bearings for all high-speed shafts, amongst other things, means a substantial saving in time when a bearing must be changed.

Important progress is shown in mechanical lubrication in up-to-date excavators—gears running immersed in oil baths and special enclosed splash lubrication are among many of the new features which go to satisfy a long-felt want in machines of this class.

In order to prevent the loosening of parts after hard wear riveting and welding are displacing the practice of bolting sections

[1] A. H. Hubbell. *Engineering and Mining Journal*, March, 1932.

FIG. 9.—CRACKED MANGANESE-STEEL SHOVEL BUCKET, SHOWING WELDED REPAIR.

in excavator construction and in some machines even the use of riveted connexions have been almost completely discarded, electrically-welded connexions being employed instead, rivets or bolts being used only for parts which must be removed for renewal. Successful welding in excavators is not confined to construction work, but is now used to a great extent in repairs with satisfactory results in both compactness and strength. A successful weld made on a cracked manganese steel bucket on a shovel is shown in Fig. 9 and illustrates the useful possibilities of this means of effecting repairs, even on manganese steel.

POWER FOR EXCAVATORS.—Although the question of the application of electrical power for excavators was discussed and tried twenty years ago, steam to within the past few years has held a dominating position as the motive power for all sizes and types of excavators. Quite suddenly, however, electricity has come into its own in the case of large excavating machinery, but still has a rival in the shape of Diesel drive in the small machines, while steam has been almost completely overshadowed, except on big isolated machines working out of reach of an electrical power supply.

(To be concluded.)

A NEW THICKENER

By D. CAMPBELL MACKENZIE, M.I.M.M.

The author describes a plant for the continuous thickening of sludge that is now undergoing tests in this country.

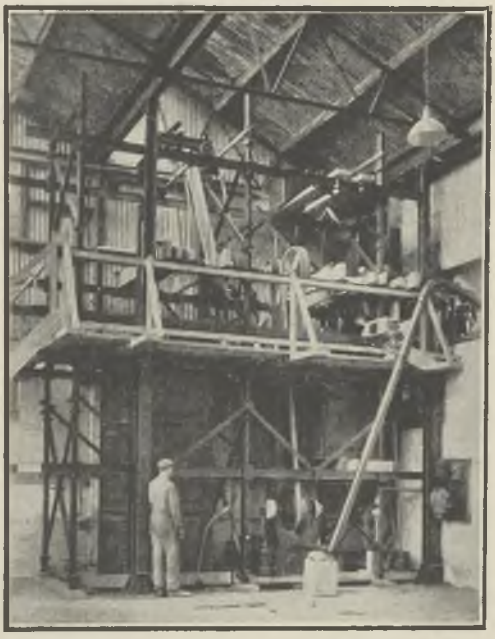
The writer has been extremely interested in a device that appears likely to be widely applicable to ore-dressing and industrial processes. It is known as the "Blomco" thickener and consists of a tank containing filtering elements submerged in the pulp which has to be thickened. The tank is kept constantly supplied with the pulp. The elements are connected by flexible hoses to a "header," which forms the suction end of a wet vacuum pump. A section of this header is enlarged, forming a cylindrical drum. Finally, the thickened sludge is continuously discharged, either by a variable-stroke diaphragm pump or by a gravity valve, according to operation requirements. The automatism of the whole plant is assured by a two-period "water-clock" device, which forms a most ingenious and simple automatic control.

The brief description that has been given emphasizes the simplicity of the whole plant, but two novel features require a more detailed reference. They are—(1) the "elements" and (2) the two-period water-clock.

(1) *The Elements.*—These have been specially designed to act as a non-rigid filtering medium and it is this novel faculty that permits of the removal of the thickened cake of sludge without recourse to mechanical scraping or air blast. An element consists of a metal tube (6 ft. long and 6 in. in diameter), in which a certain number of holes are drilled. The tube at each end has a flange about 2 in. wide. To the peripheries of these flanges the filtering canvas is stretched, leaving an annulus of about 2 in. between the tube and the cloth. This annulus is packed with a resilient medium, such as rubber or springs.

On the vacuum pump being started filtering begins, the clear liquid solution passing from the interior of the elements to the pump. Conveniently placed glass inspection sections indicate whether clear or muddy liquor is coming through. During the whole of the filtering period the filtering medium

is in a state of contraction (and consequently alteration of original shape), owing to the reduced pressure (about 12 lb. per sq. in.) inside the elements. When an economical weight of thickened cake has accumulated on the outside of the elements an automatic release-valve opens, the vacuum is destroyed, and the back-flow of water from the cylindrical drum on the suction header floods all the elements. As a result the thickened cake slides off and falls to the bottom of the tank, the filter cloth at the same time being cleaned by a small quantity of the clear liquid sweating through the cloth from the interior of the elements.



EXPERIMENTAL THICKENER UNDERGOING TESTS.

This positive discharge of the thickened cake is due to the fact that the filtering medium alters its shape while under reduced internal pressure and resumes its original shape as soon as the internal and external pressures are equated—*i.e.*, when atmospheric pressure has been restored.

(2) *The Water-Clock.* — The complete absence of springs, gears, or delicate parts in this two-period mechanism makes it a control of almost mathematical precision and practically fool-proof. The water-clock is so devised that both the filtering period and removal-of-cake period can be controlled and varied at will.

When the writer saw the machine being demonstrated slate dust was being used to form a sludge and under these conditions the filtering period was fixed at 8 minutes, 40 seconds being allowed for flushing and removal of the thickened cake. As the lifting and dropping of the automatic valve are practically instantaneous, it can be seen that each complete cycle (with slate dust) occupies 8 minutes 40 seconds.

The writer watched the machine work for long periods and was impressed with the manner in which this automatic device controlled the cycles without missing a beat. After being set to trip the valve at the appropriate intervals, it was not necessary to give it any further attention.

With regard to the power required to work the machine, this is solely that required for the wet-vacuum pumping of the clear liquid from the elements and it would appear that the designer has made a distinct step forward with this machine. There is, of course, nothing new in vacuum filtering, but an element that gets rid of its thickened cake of sludge so easily and quickly and without injury to the filter cloth is a distinct novelty, while the perfect automatism of the machine must appeal to all engineers who want to keep their running costs down.

To particularize, the writer believes that the following claims made by the makers are justified :—

(*a*) For the same throughput the space required to instal a " Blomco " thickener is relatively about 1/30th of that required for a natural settlement thickener.

(*b*) It is a positive thickener and not dependent on natural settlement or the use of lime.

(*c*) The thickened product obtained is better than that which can be obtained by natural settlement.

(*d*) Filter cloths do not require removal for washing or scrubbing and need changing only when they fail owing to old age, unless, of course, a destructive pulp is being treated. Individual elements can be shut off, if found necessary, without interfering with the other elements, while a defective element can be replaced in about two minutes, without stopping the plant.

(*e*) Everything is designed for continuous and easy operation in isolated regions. No special skill or precision tools are needed. A mechanic with a reasonable knowledge of vacuum pumps could operate a whole nest of these machines. Even should the thickener be stopped for a month there would be no

difficulty in starting up at once, neither coaxing nor expert knowledge being necessary.

(*f*) Filtering liquid from each element is visible.

(*g*) No scraping mechanism is necessary in the tank.

With regard to capacity, the writer was told by the designer that the existing commercial unit is capable of thickening pulp containing from 25 to 80 tons of solids in 24 hours. The variation is due to the nature of the solids, the lower figure being for, say, ochre or slate dust and the higher for auriferous ores of the Rand type. The fact that the machines are of British design, material, and manufacture is encouraging from an Empire standpoint.

NEWS LETTERS

JOHANNESBURG

April 6.

Aerial Surveys.—The aerial survey of the farms in the South-West Rand originally optioned to the New Consolidated Gold Fields and subsequently transferred to the West Witwatersrand Areas, Ltd., is reported to be making good progress. For the purpose of amplifying the results already obtained by magnetic prospecting, photographic mapping was taken in hand. The most formidable portion of the task, the co-ordination and sifting of the data, will probably take several months. Major R. Cochran-Patrick is in charge of the operations and is using a single machine. Up to now about 150 square miles of the countryside have been photographed. Roughly speaking, the survey region stretches from Randfontein to Potchefstroom and is about 40 miles long by about eight miles wide. Each picture is taken at a height of almost two miles—10,000 feet to be exact. Later on the "primary" general survey, if results justify it, will be followed by a series of more detailed and more numerous photographs taken at a lower altitude. Thorough collaboration between the magnetic prospecting experts and their aerial colleagues is maintained and a great mass of valuable data has thus been secured. Far East and South-East Rand areas are also being photographed from the air and it is hoped eventually to procure a record of the entire Witwatersrand by this means.

Witpoortje Gap. — The claim-pegging activity has extended to what is generally known as the "Witpoortje Gap" area, on the West Rand. Blocks of claims totalling close on six hundred have been pegged, chiefly on the farm Witpoortje No. 44 and lying mostly to the south of the main Witpoortje fault and to the north of the Roodepoort fault. It is reported that a large area is being floated into a limited liability company, having a nominal capital running into six figures, which company will proceed to open up the main ore-body, which has been proved to traverse the ground from east to west. It is believed that the reefs being prospected belong to the Coronation Series, which immediately underlies the Government Reef Series and comprises the major portion of the strata lying between the Witpoortje and Roodepoort faults. There have been numerous flotations on this area in the past, several of which expended considerable sums on drilling. It appears from the latest Government statistics that there were 57,429 total claims of various kinds held in the Johannesburg area in June, 1932, and 62,311 at the end of January last. In the Barberton district the respective figures are 18,039 and 23,006 claims. Whereas in the former district the areas were mostly pegged as prospecting claims, in the latter they were, as usual, taken up as base-metal blocks. Heidelberg, in the same period, has increased its pegged area from 8,358 to 11,415 claims and Klerksdorp by several hundred only. In the Pilgrims' Rest district, on the other hand, the number has decreased from 17,896 in June last year to 9,778 at the end of January and the Pietersburg figures have fallen from 24,212 to 22,507. The February figures will doubtless show a considerable advance.

Neuras Goldfields.—It is reported from Windhoek, South-West Africa, that good progress is being made in the development of the goldfields at Neuras, near Rehoboth. The recently-formed company, known as the Rehoboth Mining and Development Co., Ltd., is now installing machinery and plant and up to the present the directors are fully satisfied with the development. Other companies have been formed and are working claims. The Solar Development Company,

a Canadian organization, which has been prospecting in that territory for the last three years, is developing claims at Nattas, some 60 miles from Neuras. Companies in the Union have sent up prospectors, who give favourable reports on this reef, and the Inspector of Mines has expressed satisfaction regarding the development work.

Miners' Training.—The annual report of the Transvaal Chamber of Mines shows that at December 31, 1932, there were 509 apprentices undergoing the prescribed course of training at the Government Miners' Training Schools, as compared wth 531 at December 31, 1931. From the beginning of 1917 to December 31, 1932, 1,725 apprentices completed their indentures. The net cost of maintaining the schools for the twelve months ended March 31, 1932, was £56,961, of which £14,240 was contributed by the Union Government and £42,721 by the industry.

Witwatersrand System.—At the annual meeting of the Geological Society of South Africa, held in Johannesburg, Dr. L. T. Nel, the retiring president, made an interesting statement concerning the characteristics and behaviour of the rocks belonging to the Witwatersrand System in areas that lie beyond the Witwatersrand itself. In discussing the conditions under which the Witwatersrand beds originated Dr. Nel said : " Of the theories that have been advanced Dr. Mellor's exposition of the deltaic origin and, more recently, Dr. Reinecke's grounds for putting forward a terrestrial origin of the Witwatersrand beds must be considered the most authoritative. Of the various districts considered here none can compare in importance with the Witwatersrand from the economic point of view. The frequent presence of auriferous conglomerates has been proved in the Witwatersrand exposures of the other areas, but the distribution of gold in these is desultory and similar to what obtains in the Government, Kimberley, and Elsburg Reefs for example. Consequently the mining ventures in these areas have not been able to develop to the same extent as on the Rand. Gold is widespread in the Witwatersrand System, but rarely were the conditions of deposition as favourable for the concentration of it into limited zones as in the case of the Main Reef Group of conglomerates. As pointed out by Dr. Mellor, it is not so much the actual amount of gold present in the Main Reef Group which appears exceptional as concentration within particularly well-defined and continuous beds."

Northern Transvaal.—A company has been formed in Johannesburg to open up a gold-bearing body of banded ironstone which reaches a width of over 200 ft. and which has been traced over a distance of three miles on a property near the Shingwedzi Game Reserve. It is stated in one of the reports on the property that a prospecting shaft was sunk at a point which showed a well-defined body of ore. The opinion is expressed in the report that further development will expose an enormous body of payable reef and at depth will show increasing values. The ore is said to be amenable to the same treatment as the ores of the Witwatersrand. The company has secured an initial plant capable of treating about 1,000 tons per month.

Klerksdorp Geology.—Members of the staff of the Anglo American Corporation are paying close attention to the geological features of the Klerksdorp district in connexion with a scheme whereby the corporation and its associate, the Rand Selection Corporation, have the right to take over a large number of options on mining rights in the district.

Expansion at Randfontein.—Work in connexion with the Randfontein Estates' new large construction programme is now in full swing. The company is erecting eight new staff quarters, a compound of 120 rooms, a block of offices at Millsite, a new European employees' hospital costing £14,000, offices, stores, and change-house at No. 2 north shaft, and new offices at Robinson which are expected to cost £10,000 to complete. These buildings form but a small part of the entire plant expansion on the mine and are to be followed by the installation of new reduction and cyanide plant, together with new hoisting machinery at No. 2 north shaft and air compressors at two of the main shafts of the mine. Preliminary work has commenced on the excavations for the new reduction plant.

New Mill.—In the Murchison Range, Northern Transvaal, work has been started at a small gold mine equipped with a new type of mill. As the result of private demonstrations of its capabilities conducted in Johannesburg, two of these mills have been sold to Barberton mines and another two to Rhodesian mines, but this one in the Murchison range is the first actually to be started up to mill ore. Its operating results will be awaited with considerable interest by small producers, for whose work and means it is said to be particularly suitable.

BRISBANE

March 29.

Mount Isa Production.—The Mount Isa mine reached the apex of its production for one week when for the seven days ended March 18 1,387 tons of silver-lead bullion was recovered from 16,107 tons of crude ore. During the same period 1,438 tons of bullion was trucked to the coast at Townsville. Subsequently a serious blow-out occurred in the dynamo in the engine room, causing considerable delay in operations. Diamond drilling was continued underground during February. The information obtained from H 52 hole, which was completed at 100 ft., confirmed the geological projections from the main drives. In January the supply of water in the Rifle Creek dam, which has a capacity of 1,100,000,000 gallons, was low, but heavy rain early in February caused the reservoir to overflow again.

Mount Morgan Progress.—The present Mount Morgan Company has been able, while carrying out the programme laid down, to repay to the State Government the whole of the £15,000 which had been advanced out of the Commonwealth States loan for the relief of unemployment, together with £762 from the unemployment relief fund. The company, it is stated, has kept well within its original estimates and has developed its plant so satisfactorily that no additional accommodation has been needed. At the mine official reports indicate operations are proceeding satisfactorily. At present about 250 men are being employed and the number is being steadily increased. In January the quantity of ore produced was 5,098 tons, while the ore concentrates totalled 5,410 tons, producing 300 tons of concentrates, estimated to contain 2,104 oz. of gold and 21½ tons of copper. The greater part of the ore obtained is now being got from the floor of the open-cut and the Linda level. With the ore being hauled through the Linda tunnel, as at present, the traffic is too congested to permit of the transport of waste also, so that No. 14 shaft is being converted to take the waste from the mill. No. 3 section of the concentrating mill is ready for use and this, when in full operation, is expected to increase its capacity to about 300 tons per day.

An Interesting Mine.—A short time ago some sensational reports were published concerning a gold discovery at what is now called the Federal Flag mine, in the Chillagoe district, North Queensland. A Government geologist now reports that the production of gold on this lease has been obtained from what he describes as phenomenal specimens, which marked the enrichment of a vein of calcite at or adjacent to its intersection with a vein of marcasite. At the time of the geologist's visit there had been bagged for shipment 10 tons of ore estimated to produce 10 oz. of gold to the ton. The geologist's conclusion is that, while it appears that the rich shoot of ore will follow the marcasite intersection downwards, other ironstone intersections might be carefully looked for on the projection of the calcite vein.

Lolworth Creek Gold.—From the new field at Lolworth Creek, in the Charters Towers district, North Queensland, news has lately been received that at the Big Shine mine, over which Lillaya Tin, N.L. (a Sydney company) has an option, development has disclosed highly improved values. The new battery erected on this field, after having been delayed in starting for want of water, was put out of commission during February.

Cloncurry Copper.—The copper industry in the Cloncurry field, the chief producer of this metal in Queensland, is in a bad way owing to continued low metal prices. All ore produced in the district is sent to the State smelters for treatment. Until lately the flat rate paid by these smelters was about £9 over the market price, but the Government have been compelled to readjust the rates, with the result that the industry will go from bad to worse. There has been some agitation for the erection of central smelters in the district, the number of medium-grade mines that are closing being urged in support of the agitation. Mount Oxide, which usually has employment for some 50 men, now has only a small crew raising ore broken before the new rates became operative.

Mount Coolon Operations. — The English company, Mount Coolon Gold Mines, N.L., operating on the Mount Coolon goldfield, Queensland, has crushed in 14 days 2,332 tons, which yielded bullion containing 1,433 oz. of fine gold. Crushing is still being carried on at the rate of 250 tons a day. As the ore is being rapidly stoped out at the 300-ft. level, work is now being carried on at the 450-ft. level. A cross-cut has been put in 80 ft. from the shaft, but over 100 ft. will have to be driven before the reef is cut.

Oil from Coal.—The Acting Prime Minister (Mr. J. G. Latham) has informed the House of Representatives that the Federal

Government is in possession of a great deal of up-to-date information respecting low-temperature carbonization and other processes for extracting oil from coal, but that no facts have emerged which would appear to justify the Government in taking action.

Oil in Victoria.—Oil Search, Ltd., which has shareholders in Queensland, has for a good while been boring for oil at Lakes Entrance, in the Gippsland district of Victoria. It has produced 60,000 gallons of oil, which it is claimed is sufficient to warrant Gippsland being classed as an oilfield — the first in Australia. It is expected that before long Oil Search, Ltd., will be able to announce, as the result of its work, the disclosure of a closed structure and in this event, in the opinion of Sir Edgworth David and other geologists, the prospects of a major oilfield being established would be excellent.

Broken Hill Proprietary.—The Broken Hill Proprietary, Ltd., besides entering the sphere of gold mining, has decided to establish a tinplate manufacturing industry at its iron and steel works, Newcastle, New South Wales. Considerable expenditure will have to be made on new plant and production is to begin within twelve months. Much employment will be provided both by the manufacture of steel for the tinplate and in the making of tinplate itself. At present Australia spends about £1,000,000 a year in Great Britain on tinplate.

Coolgardie Low-Grade Ores.—Some time ago the Broken Hill Proprietary, Ltd., took a working option over the Brilliant leases, situated about half a mile from the Coolgardie State battery, but the sampling did not come up to expectations and the option was abandoned. Now other Broken Hill interests have taken the property in hand and have started to crush the big tonnage of ore raised by the previous option holders. This ore is expected to average 3 dwt. by amalgamation and at that rate will be payable. On these leases much rich ore has been obtained in the past, but the main features are the big low-grade lodes, which go up to 20 ft. in width and are easily broken and treated.

New Zealand.—A company called the Golden Central, Ltd., has secured, near Cromwell, Central Otago, New Zealand, two 500-acre leases, where an alluvial lead was discovered in October last by two prospectors. Since this discovery, it is stated, these men have averaged 11 oz. of gold a day by hand sluicing and they have washed up as much as 60 oz. in three days. The New Zealand Government has made a geophysical survey of the country under the guidance of Dr. Marsden, superintendent of the Scientific and Industrial Research Department. The Golden Central Company is commencing immediately to bore the 1,000 acres under the guidance of Dr. Marsden.

IPOH

April 10.

Restriction.—The terms on which the International Tin Control scheme may be continued after August, 1934, have been and are still matter for discussion and consideration in this country. An extraordinary meeting of members was held in the offices of the chamber here on April 8 to give producers or their representatives opportunity to express opinions on problems relating to the policy and terms under which, if at all, restriction should continue. As the purpose of the meeting was to give members opportunity to be informed and to express individual views there could be no resolutions nor expressions of majority opinion by vote, but members who are or who represent producers are asked to send written replies to certain questions which have been circulated to them. It will be clear to anyone who considers critically the position of the producers that there may be great divergencies between the interests of actual producers and those of persons or organizations mainly interested as sublessors, or as vendors of quotas, or as holders of stocks of the metal. Approval for restriction in this country depended upon and was obtained from the actual producers at the time, but there is and has been for nearly two years a growing tendency, especially in rules and instructions under the Restriction Enactment, to give undue and in some cases unfair advantage to interests which are not those of the producers.

Sale of Quotas.—It is open to question whether some of the present advocates of continued restriction on "the best terms obtainable"—which means practically any terms—are really interested as producers or are in the more fortunate position of vendors of quotas. Grouping of a few mines for economical production by those most conveniently circumstanced, keeping experienced labour employed and the mines in condition to resume normal production at short notice, was a helpful policy as at first permitted,

but policy changed and on the one hand approval was given for the formation among Chinese producers of very large groups in connexion with which influence rather than economy seems likely to have been the object and on the other hand difficulties were introduced by rulings affecting ordinary grouping. At about the same time the transfer—which in practice means the sale—of quotas was permitted and this facility has been very widely and freely used at prices so profitable that some of those who by selling their quotas have really ceased to be active producers are receiving so good an income that they may wish restriction to continue for ever on terms involving no labour, risk, or responsibility. The short point of the foregoing is that the unfortunate producer whose consent to conditions of restriction is now once again being sought seems to be the least fortunate of those who are financially concerned with it. Little insight is required to realize that some of the above-mentioned tendencies are injurious to the interests of this country. In the first place there is no reduction in output below the maximum permitted figure, but a considerable amount of hardship among miners unfortunately circumstanced and affected by the frequent new rulings. Serious loss of labour results from the freely-permitted sale of quotas and labour is an asset to these States. The loss of labour means loss of business and of the means of livelihood to others besides miners in the community and, in fact, the internal administration of restriction urgently needs revision. It would surely be possible to come to a reasonable arrangement with the Government of the Netherlands Indies under which their production could be regulated in consultation with producers in Malaya. It is at least certain that subject to reasonable and adjustable agreements a large proportion of mines which are actual producers in these States must benefit substantially if the present troublesome and in many ways unfair restriction regulations, rules, and decisions were to be cancelled.

TORONTO

April 20.

Porcupine.—The gold production for this field during March amounted to $2,049,141 from the treatment of 285,040 tons of ore, compared with $1,733,265 from 256,653 tons of ore in February. The annual report of Dome Mines for the year ending December shows that, after providing for all expenditure, exploration, depreciation, reserves, etc., the net profit is $1,931,401. The bullion production amounted to $4,041,317. The production for March amounted to $412,565, the highest monthly record since 1928 and an increase of $31,202 over the February output of $381,363. During the year a total of 536,450 tons was treated, yielding an average grade of $7·92 per ton. The ore reserves at the end of 1932 were estimated at 2,000,000 tons. The Hollinger Consolidated is opening up new ore in the Schumacher section, which is running well above the mine average. It is planned to continue sinking and open up several new levels. McIntyre Porcupine have declared a dividend of 25 cents per share, together with an extra dividend of 12½ cents and a bonus of 12½ cents. The Vipond is meeting with good results in their search for new ore-bodies. Diamond drilling has intersected a new vein below the 1,400-ft. level. The Mammoth Porcupine Gold Syndicate has been organized to take over the property of the Mammoth Porcupine mines in the south section of the field.

Kirkland Lake.—The value of the bullion produced by the mines of this camp amounted to $1,858,867 from 141,716 tons milled, compared with $1,789,399 from the 136,988 tons of ore milled the previous month. Lake Shore is maintaining production in excess of $1,000,000, exclusive of premium. Proposed changes in the mill and the installation of a new unit, which is expected to be completed and in operation by the end of June, will, it is hoped, cause output to show considerable expansion and reduce the loss of gold in tailings. Despite the losses the total production of the mine for 1932 amounted to $12,647,128, with an average recovery of $15·40 per ton. Considerable development work has been done on the property of the Kirkland Gold Belt, in the eastern section of the camp, which has been attended with much success. The management have decided to install a 50-ton mill without delay and it is expected the mine will go into production by November. Changes will be made in the power plant, enabling the sinking of a shaft to a depth of 750 ft. Barry-Hollinger is pushing development on the new sections opened up and obtaining good results. The mill has been closed down until the new zone has been further explored. Shaft-sinking at the Teck-Hughes is proceeding with satisfactory

results in connection with the deep development programme. Diamond drilling is being continued with the object of picking up the continuation of the north vein located some time ago by Lake Shore. At the Kirkland Lake Gold Mines the No. 2 winze is down below the 4,900-ft. level, where massive porphyry similar to that on the Teck-Hughes property has been encountered. Officials at Macassa Mines are considering the installation of a mill which, it is stated, will have a capacity of 500 tons per day. Plans are under way to commence operations at the property of the Miller Independence Mine, in the Boston Creek area.

Other Ontario Goldfields.—The Ashley, in the Matachewan area, is extending its high-grade vein system underground. One vein, showing a width of 30 in., has been opened up for a length of 200 ft., with gold averaging $15 per ton. Mine development and bullion production at Parkhill Gold Mines, in the Michipicoten area, are showing improvement and the management has commenced an extensive programme of underground development. The mill, which resumed operation about a month ago, is working on a reduced tonnage of high-grade ore with mill heads of about $30 or $40 a ton. The Cormac Mining Syndicate, in the same area, has taken an option on a group of four claims. An important discovery carrying free gold has been made on the property of the Bloom Lake Consolidated Mines. Diamond drilling will be undertaken and an extensive test of the property will be made. Preliminary work in connexion with a large programme of development is under way at the Shaft Island Gold Mines, in the Abitibi district, where a vein has been disclosed for 225 ft. At Central Patricia Mines, in the Patricia area, the production will be delayed, owing to the loss of two loads of heavy machinery through the ice. For the quarter ended March the Howey Gold Mine treated 87,000 tons of ore and recovered bullion to the value of $232,000, the recovery per ton being $3·24. Owing to changes in the milling plant operations were delayed. In the Great Bear Lake region plans are being made for an active programme, prospectors and supplies are going into the district, and many mining companies are pushing forward development.

Sudbury.—As a result of an increase in the sales of their products and a drastic retrenchment and cutting down of all capital expenditure, the International Nickel Company reports a net gain for the last quarter of 1931. An effective sales policy, especially an increased trade with Japan and Germany in the sale of nickel and copper, had enabled the company to maintain consumption of its product above production and to renew operation of certain of its idle plants. The Falconbridge Nickel Mines has resumed operations with a new concentrator, sintering plant, and an enlarged smelter in action. With these new additions the mill has now a rated capacity of 1,000 tons daily. Hoisting facilities have also been provided to meet this increase. It is estimated that the volume of the metal output will be increased. Much attention is being centred around the claims in the Swayze area and many companies are sending in men and mining equipment to begin active development.

North-Western Quebec.—Operations at the Noranda for the first quarter of the year show a decline, compared with the corresponding period of 1932. Two causes are given for this decrease, one that during February the company made extensive furnace repairs and the second the drawing of a lower grade of ore. The gold production for the year showed an increase from 253,363 oz. in 1931 to 341,350 oz. in 1932 and in value an advance from $5,337,737 to $7,905,131. The copper production was practically the same in poundage, but the value decreased from $5,000,565 to $3,699,523 in 1932. The new ball-mill recently installed at the Siscoe is in operation and will treat 250 tons of ore daily. During March 4,779 tons of ore were milled, producing bullion to the value of $95,360, with an average recovery of $19·93 per ton. Satisfactory progress is being made at Granada Gold Mines with development operations, especially in the eastern section on the 625-ft. level. The new Hadsel mill has been adjusted and is now working satisfactorily. The Canadian Panadora, in the Cadillac district, is obtaining favourable results in diamond drilling. Further work of sinking to the 500-ft. level is planned and consideration is being given to the installation of a 10-ton pilot mill. Development work at the Stadacona is making good progress, a station is being cut on the 300 ft. level, and further preparations for drilling are being made. The shaft is being enlarged and sinking will be continued to the 1,000-ft. level. The McWatters Gold Mines is still making steady progress

and a new plant is to be installed. The shaft is now down more than 100 ft., but sinking is to be suspended for a short time while adjustments are being made.

Manitoba.—The annual financial statement of the Hudson Bay Mining and Smelting Company for 1932 shows a net profit of $1,398,141, as against $1,029,928 in 1931. After provision for depreciation, discount, expenses, etc., there was a deficit of $298,955. Metal sales for the year amounted to $5,406,668 and, while the output of copper and zinc showed a favourable improvement, the increase in the gold content of the ore treated is the main factor in enabling the company to continue operations. Two new veins have been discovered on the property of San Antonia Gold Mines by diamond drilling. Production is being maintained at a high level and the daily capacity will be increased to 160 tons. Continued favourable results are being obtained on God's Lake Gold Mines and much activity is in progress. An early start will be made on development operations at the property of Little Long Lac Gold Mines. Equipment, including a complete mining plant, capable of carrying work to a considerable depth have been taken in. In the Central Manitoba field the Vanson Gold Mines is planning early production. A mining plant is on the field and a 25-ton mill is being installed.

Canadian Institute's Annual Convention.—The 34th annual convention of the Canadian Institute of Mining and Metallurgy was held at the Royal York Hotel, Toronto, for three days, April 5–7. There were about 400 men engaged in the mining and other metallurgical industries in attendance. The outstanding feature of the afternoon session was the reading of two important papers in which the remonetization of silver was urged. The discussion was commenced by a paper delivered by Dr. Mackintosh Bell, consulting engineer. He advocated the harmonizing of the gold standard in Occidental countries with the age-old silver mentality of the Orient. Since the dawn of history, he said, gold and silver had been used as money. The elimination of silver seemed to have accentuated disequilibrium rather than to have increased co-operation. Another paper, presented by Mr. H. E. Denny, consulting engineer, was in the nature of an expansion and elaboration of Dr. Bell's thesis. Mr. Richard Pearce, of Toronto, presented a paper justifying the action of the Canadian Government in bonusing the mining industry. A paper by Dr. Charles Camsell was read dealing largely with Canada's production of base metals, which was followed by an address by Mr. L. L. Blaylock, who emphasized the importance of wise salesmanship in increasing the market and price for base metals abroad. Mr. Cyril Tasker, of the Ontario Research Foundation, described experiments for treating Ontario lignites to withstand exposure and transport. A noteworthy feature was an attack by several engineers on a report on the Hollinger mine by Dr. Graton, of Harvard University. Dr. Sydney W. Smith, president of the Institution of Mining and Metallurgy, contended that they must continue to recognize values by recognized standards, guard zealously the standards set up in the past, and place greater stress on art in industry. The mines of Canada, he said, presented a vast field of inquiry and many new problems and they should reach out into the field of research more extensively. The annual banquet was held on the evening of April 6, at which the principal speakers were the Hon. R. B. Bennett, the Hon. Westley Gordon, Minister of Mines for the Dominion, the Hon. Charles McCrea, Ontario Minister of Mines, and Dr. Sydney Smith.

VANCOUVER

April 10.

Sheep Creek. — With the successful outcome of negotiations for financing the development of the Gold Belt property this mine, which is favourably situated on the same quartzite belt as the Queen and Reno ore-bodies, is likely to attract considerable attention during the present season. The underground development work that is now under way stands every chance of proving it to be a profitable mine. Arrangements have already been made, contingent upon the anticipated success of the development, for the construction of a 3,500-ft. aerial ropeway for delivery of ore to the Reno mill for customs treatment. For the exploration work a substantial camp has been constructed, a transmission line run in from the Reno mine power installation, about 3,000 ft. long, heavy compressor equipment installed, and a tentative agreement made with the Reno company for custom treatment of ore from development. Recent advices from the Reno mine are to the effect that the No. 5 tunnel has passed through the fault area beyond the downward extension of the first oxidized

ore-shoot on the 4th level and has encountered the sulphide ore characteristic of the inner primary sulphide ore-shoot, upon which the best prospects of persistence of the ore-body depend. This tunnel has now been driven for over 1,550 ft. It is stated that the mill capacity is being stepped up gradually and that a good extraction is being made. The third carload shipment of ore from the Kootenay Belle mine to be made this year was dispatched recently to the Trail smelter. Since development of this property was resumed last September returns from shipments have exceeded $9,500. Capital is now being raised for more extended development and for erection of a treatment plant. There are two veins on this property that have been opened up from cross-cut tunnels, in addition to further showings on adjacent claims. Narrow ore-shoots were stoped on both of these veins in earlier days, but it is understood that recent work has demonstrated the fact that the main ore-body lies in the hanging-wall of the original workings and driving has proved a considerable increase in the lateral extension of one ore-shoot at least on the lower level of the mine. The property of Kootenay Belle Gold Mines, Ltd., covers 182 acres under Crown grant and there are important possibilities in connexion with the extension of known veins such as the Queen and Yellowstone into the quartzite formation that is included within this area. It is understood that plans for the coming season provide for more extended development of the property.

Boundary.—The shaft workings of the Morning Star property, covering a typical occurrence of the large low-grade gold-quartz veins of the Fairview camp that attracted a great amount of attention 30 years ago, have now been examined, after having been unwatered down to the 80-ft. level. The ore-body has been sampled thoroughly by the Granby company, which holds an option upon the property, but if this is not exercised it is understood that the holdings may be acquired by the Federal Mining and Smelting Company, whose representatives have also been on the ground. This latter company retains large interests in the camp. The Hecla Mining Company, of Wallace, Idaho, is continuing a certain amount of work at the Union mine, where it is rumoured that another small stringer of very high-grade ore has been encountered. The work at this mine is, however, devoted mainly to cleaning up spots of ore that were left in the stope and a small tonnage is being accumulated for treatment in the Spring. The company is devoting its operations in this camp principally to the exploration of the adjoining Homestake property, where a shaft has been sunk to a depth of 100 ft., and cross-cutting and driving work is being carried out on this level. It is said that gold values were encountered continuously in the shaft-sinking work, with commercial amounts in occasional patches of ore. The work is being done by hand at the present time, installation of mechanical equipment depending upon the results of the exploration at the 100-ft. level. The company made a net profit of $63,721 out of the operation of the Union mine, the purchase price of which was met out of royalties on ore-shipments.

Nelson.—Work is stated to be proceeding rapidly on the Venus-Juno-Athabasca groups of properties that were acquired recently by Noble Five Mines, Ltd. A drive is being run on the Juno vein that is said to be exposed over a width of 4 ft. and on the evidence of surface showings it is anticipated that this work, which is expected to be completed shortly, will open up an ore-shoot 250 ft. long with backs of 150 ft. If the results of this preliminary work prove to be satisfactory the development of the veins at greater depth, for which excellent facilities exist, will be undertaken.

East Kootenay.—Good progress is said to be made in the work on the amalgamated properties of the Meridian Mining Company. This is being carried on in two sections—the Eva and Oyster-Criterion claims. On the former it is stated that driving is opening up a large tonnage. The Eva vein was approached from the old Galena tunnel and at the point of intersection it is reported that the ore-body was 10 ft. wide. Consolidated Mining and Smelting Company has acquired a group of claims on the magnesite belt, Marysville, that was discovered recently during the course of geological field work by Dr. C. E. Cairnes. This occurrence is said to compare favourably with any known commercial body of rock magnesite.

Bridge River.—It is reported that the Coronation workings of the Bralorne property are to be reopened. This claim adjoins the holdings of the Pioneer Company on the south-east and the ore-body was at one time the object of an individual operation. With the near approach of the underground workings of the Pioneer mine to the boundary and with the favourable aspect in regard to lateral extension that has been afforded by

the more recent developments in this mine, the Coronation holdings of the Bralorne company are looked upon with increased interest and it is understood that a more general programme of development is to be commenced with a view to exploiting possibilities other than those confined to the King vein, to which all the work by the company has been devoted up to the present time. The extension of the east drive on the 7th level of the Pioneer mine continues to open up ore of a good grade beyond the point at which it was thought previously that the vein was bounded in this direction and it is understood that lateral development on the lower levels also has been productive of good results in both directions. The main vein has now been proved to extend for well over 2,000 ft. The Wayside property, in the main valley of Bridge River, has been acquired by a Vancouver syndicate and equipment is being installed for the purpose of continuing development. Further interest in the area has been inspired by reports that the Britannia company has taken over the Pioneer Extension property from Home Oils, Ltd., by which company it was acquired last year from the Pioneer Extension Company. Considerable attention is being paid to this upper section of the Cadwallader Creek, following the report of the resident engineer, who outlined important possibilities in connexion with it. It is reported that a tunnel that was driven on the Dan Tucker claim has encountered a vein 3½ ft. wide and this is believed to represent the extension of a showing on the adjoining Red Hawk property, upon which a large amount of surface prospecting was done last year. Referring to this section, the resident engineer says that it deserves opening up in a number of places.

Coast.—Developments that have been in progress during the past three years at the Surf Point property on Porcher Island are reported to have been sufficiently satisfactory to justify plans for the erection of a treatment plant and steps are being taken with this object in view. The property is held by Noah Timmins, Inc. It was known formerly as the Trixie group and was owned by Frank Patterson, by whom a large amount of prospecting development was done and some shipments of ore were made. In 1919 an amount of 10 tons of sorted ore was shipped to the Trail smelter and yielded good returns. The ore occurrence is described as being represented by six parallel gold-quartz veins, ranging from a few inches to 3 ft. in width in a quartz-diorite formation and there is a further showing that is referred to in a geological report as a large irregular mass of quartz veins 15 to 20 ft. wide. Careful investigations have been made of the possibilities and trial scow-loads of ore have been shipped to the Anyox smelter. These are said to have indicated high-grade milling ore.

PERSONAL

A. Beckerleg has left for West Africa.

F. W. Binge has left for the Gold Coast.

C. Burnett has left for Colombia.

Sir John Cadman has been awarded the Melchett Medal of the Institute of Fuel.

A. J. Clark is here from Northern Rhodesia.

G. T. Eve is leaving for Abyssinia.

Rowland C. Feilding has left for New York.

Cyril Frazier is now in Sierra Leone.

F. R. H. Green has left for Kenya to take up an appointment as Assistant Inspector of Mines.

C. Stansfield Hitchen has returned from the United States.

James Jackson is now in Yugoslavia.

Ross Knuckey has left for Italy and Turkey.

Malcolm Maclaren is returning from West Africa.

A. J. Morris has left for Colombia.

F. F. Oates has left for Colombia.

James W. Park is returning from the Gold Coast.

A. E. Payne is here from the Rand.

W. B. Pickering, who has for many years been associated with Messrs. Hadfields, is the new president of the Sheffield Chamber of Commerce.

John Pope has left for the Gold Coast.

D. J. Rogers is home from Yugoslavia.

S. J. Truscott has returned from Canada.

G. W. Eaton Turner is returning from the Gold Coast.

H. S. Weigall has returned to Japan from France.

Walter Currie, associated with the Globe and Phœnix mine since its early days and a Member of the Institution of Mining and Metallurgy since 1911, died on April 28.

Edward Rigg, who died on April 14 at the age of 83, was in 1873 appointed Assistant Assayer at the Royal Mint and was Superintendent of the Operative Department until 1918. He received a Knighthood in 1915.

Philip Ryk Myburgh met his death by poisoning at the fire which occurred at the Langlaagte Estate mine last month, where he was underground manager. After graduating at the Royal School of Mines in 1922, Mr. Myburgh went to Crown Mines and left there in 1925 to become acting underground manager at Van Ryn Deep. Percy Colin Whitehead, who also lost his life as the result of the fire, was formerly manager of the Berenguela tin mine in Bolivia, having been previously in Tanganyika and Nigeria. The decline in active mining in Bolivia, resulting from restriction, caused him to leave there for the Rand, where, starting as a working miner, he had advanced to the position of shift boss at the time of his death. Mr. Whitehead was a Member of the Institution of Mining and Metallurgy. W. M. Chalmers, mine captain, and R. Vivian, shift boss, were killed at the same time.

TRADE PARAGRAPHS

Commer Cars, Ltd., of Luton, send out leaflets with reference to their motor lorries, of which they manufacture a range varying from 6–8 cwt. to 6–6½ tons. The heavier vehicles from three tons upwards are six-wheelers.

G. A. Harvey and Co. (London), Ltd., of Woolwich Road, London, S.E. 7, issue a leaflet describing their perforated metal and woven wire machinery guards for protection against the danger of moving parts in the workshop.

Sir Isaac Pitman and Sons, Ltd., of Parker Street, Kingsway, London, W.C. 2, have published part 14 of their *Engineering Educator,* which continues the subject of pattern making and foundry work and commences that of fitting and erecting.

Stein and Atkinson, Ltd., of 47, Victoria Street London, S.W. 1, in the February issue of their *Modern Industrial Furnaces* have a detailed description of a cylindrical metal-melting furnace which is rotary and oil fired and suitable for the production of all types of cast iron, steel, and non-ferrous castings.

Hopkinsons, Ltd., of Britannia Works, Huddersfield, the well-known manufacturers of valves and steam fittings, issue a publication with many interesting photographs describing their works and organization, together with details of many of their products, which should be of value to the engineer in charge of power generation.

Thomas Smith and Sons (Rodley), Ltd., of Leeds, have prepared a special brochure which is fully illustrated, describing locomotive steam cranes. This indicates the class of work for which these machines are suitable and their various capacities. Examples of their employment on a variety of duties are also cited and their conversion into excavators of the grab type is indicated.

G. D. Peters and Co., Ltd., of Windsor Works, Slough, have recently published a new comprehensive catalogue describing Wilson plastic-arc welding equipment. This is fully illustrated and contains a wealth of information on the many applications of welding, together with particulars of the different types of machines—including those for specific duties—and of the requisite accessories.

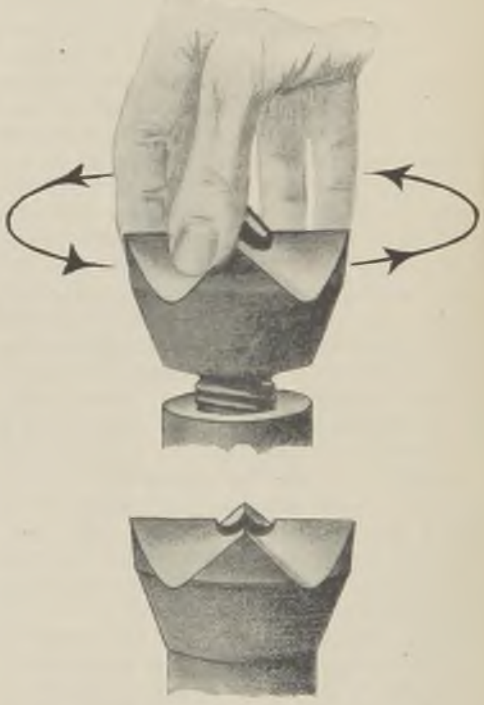
Denver Equipment Co., of 1419, 17th Street, Denver, Colorado (London Office: 840, Salisbury House, E.C. 2), are sending out a leaflet describing advances made in recent years in the metallurgy of gold, which deals more particularly with flotation, refers to recent literature in the technical press on this subject, and affords an opportunity of mentioning the Denver "Sub-A" flotation machine.

T. C. Jones and Co., Ltd., of 93–95, Wood Lane, London, W. 12, have published a bound booklet having the title "Power Transmission," which describes the specialties which they manufacture and supply in the form of couplings, bearings, shafting boxes, brackets and hangers, pulleys, "v" ropes, belting and belt lacing. The booklet is amply supplied with useful data and dimensions.

Ruston-Bucyrus, Ltd., of Excavator Works, Lincoln, announce two important orders, one being for a one-cu. yd. electrically operated shovel which is now employed on the construction of a civil aerodrome in Singapore. The other refers to a new order for two more excavators by London Brick Co. and Forders, Ltd., which employs a fleet of 35 Ruston-Bucyrus machines. The two machines are electrically operated draglines.

Austin Hoy and Co., Ltd., of Bush House, London, W.C. 2, announce that they have received an order from Anglo-Australian Gold Development, Ltd., for three complete diamond-drill plants made by Canadian Longyear, Ltd., of Ontario. These are equipped throughout with Patrick blunt-edge carbon. This equipment will be used in prospecting for gold in Western Australia on the properties of Beryl Gold Mines and Mars Gold Mines.

Padley and Venables, Ltd., of Dominion Steel and Tool Works, Sheffield, have published a number of catalogues describing their products, including drill-steel hammers, picks, and other tools, coal-cutter picks, shovels, and suchlike. Of particular interest among these is the reference to the Riley Rip Bit and Seldom Hoist rods. As will be seen from the accompanying illustration the Riley bit



Riley Rip Bit.

is screwed in the drill rod until it is flush with the face of the rod. The stud is an integral part of the bit and is scrapped with it when worn and ready for rejection. The bits are machine-made and scientifically hardened in such a way that the bit itself is hard, while the stud is tough rather than hard and so more resistant to fracture. For Seldom Hoist rods the makers claim longer life for rod and shank. They are hollow rods with a smooth bore, being rolled on an austenitic core and are made of heat-treated alloy steel, which is more resistant to fatigue and the use of which is made possible by reason of the fact that, with a detachable bit, the steel itself has not to be sharpened.

Leonard Hill, Ltd., of 231, Strand, London, W.C. 2, have published the ninth edition of their *Chemical Engineering and Chemical Catalogue.* This contains sections descriptive of the principal products of a number of chemical engineering manufacturers, an index to these manufactures, a classified index in English and Spanish, useful data and tables of interest to the chemical engineer, and a bibliography for purposes of reference.

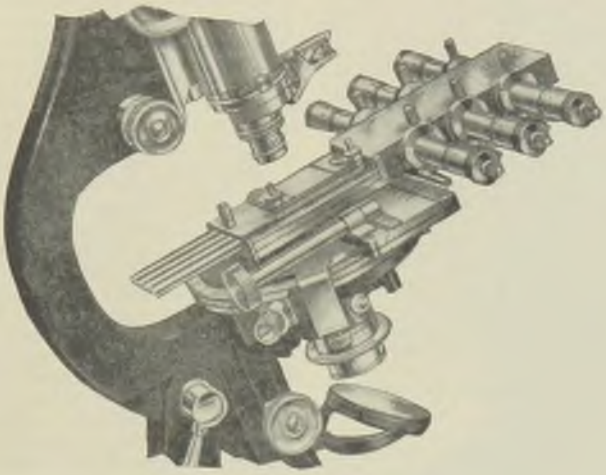
British Rema Manufacturing Co., Ltd., of Halifax, have prepared a fully-illustrated publication describing their pulverizing plant. This is specially suitable for coal pulverization, the Rema mill being of the ring roll type. The firm are, however, also manufacturers of ball- and tube-mills for wet and dry grinding, disintegrators, pinned cage mills, and disc mills. All these products are referred to, as are also such auxiliary apparatus as air separators and exhauster fans.

Bureau of Information on Nickel of the Mond Nickel Co., Ltd., of Thames House, Millbank, London, S.W. 1, publish a leaflet on the attributes of nickel alloy steels and by way of illustration reference is made to the use of such steels for rack, pinions, and gears of mechanical excavators. In the most recent publication on nickel they refer to one attribute of nickel alloy steels—namely, their resistance to wear and this is exemplified with such instances as the use of the steel for gearing, for dredge-bucket pins, and in rock-drills.

Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, have published a booklet very amply describing their research organization. This is well illustrated and contains sections devoted to high-voltage research, X-ray work, vacuum research, electro-magnetic work, transformer measurements, the testing of rotors, vibration fatigue, frequency testing apparatus, and high-temperature slow tensile and creep testing apparatus. In their *Metropolitan Vickers Gazette* for April there is an article describing oil-field electrification.

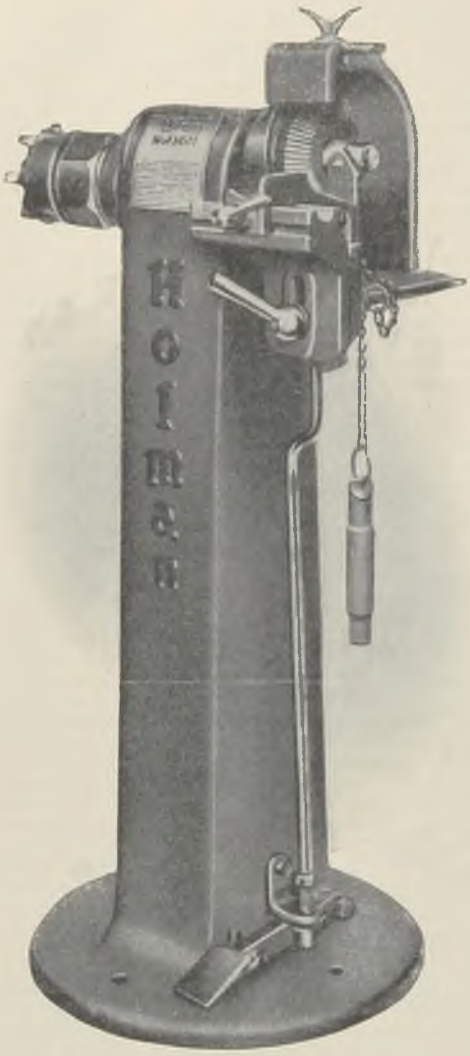
Mavor and Coulson, Ltd., of 47, Broad Street, Glasgow, have just issued a booklet describing their Meco hammer drill suitable for drilling from soft coal up to rock of medium hardness, such as blue limestone. The makers claim for the Meco KL 3 drill that they have secured an absolutely balanced stroke in the machine, which results in a less tiring effect on the operator. Examples of the drill in operation in a variety of stones are quoted and full dimensions and cross-sections are given. They also issue a leaflet describing the new face-belt conveyor, having a cross-braced construction of great strength. This consists of 6-ft. sections, each section comprising an inverted trough, which supports a side plate on each side.

Kennedy-Van Saun Manufacturing and Engineering Corporation, of 2, Park Avenue, New York (London office : Bush House, W.C. 2), issue some notes describing their pneumatic transport or conveying system for pulverized coal and other fine materials. The system has no moving parts and the only source of power is that derived from compressed air, which is required for the actual conveyance of the material. The conveyor may take the discharge from a bin or direct from a pulverizer. No air is used unless material is actually being transported and the air consumption per ton of material handled is virtually the same for all tonnages. The system also automatically weighs both material received and that dispatched.



Leitz Integrating Stage.

Ernst Leitz, of Wetzlar, Germany (London office : 20, Mortimer Street, W. 1), have sent a catalogue of their polarizing microscopes, in which is a description of apparatus for the applications of Shand's planimetric analysis, to which attention was directed in the Magazine last month in the Mining Digest. The integrating stage is illustrated here. This has six independent measuring spindles, with the aid of which the proportional amounts of six different constituents may be summed in one operation and a surface of 18 by 18 mm. planimetrically evaluated. The exactness of the readings furnished by the spindles is such that, within an integrating distance of 25 mm. along each component, the error does not exceed 0·01 mm. The release of all the spindles causes the integrating stage to return automatically to its initial position along the measuring line,



THE ROTOMILL.

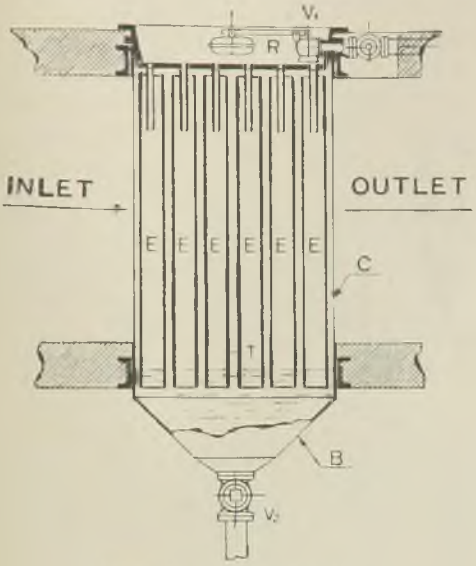
whence it may be set accurately within 0·1 mm. to a fresh line with the aid of a rack and pinion motion.

Holman Bros., Ltd., of Camborne, Cornwall, have prepared a leaflet describing their Rotomill for hot milling rock-drill bits. This machine, which is illustrated here, is operated by compressed air and is intended for use as an auxiliary to the Newgrip sharpener manufactured by this firm. It is a self-contained unit, requiring no foundation, is sufficiently light to be moved from place to place without difficulty, and is capable of dealing with bits up to 2 in. in diameter. The power unit is a vane type air motor and the spindle carrying the cutting wheels is driven through single reduction gearing. The motor throttle is controlled by the foot lever indicated, which is protected by a safety catch. Milling cutters suitable for making either cross bits or double chisel bits can be mounted on the spindle and there is an appropriate type of rest for drill rods for either operation. The leaflet contains directions for the use of the two kinds of milling cutter indicated and points out other types of bits which can be hot milled with equal ease. They also announce that they are erecting and equipping a factory at Johannesburg for the manufacture of certain parts of their rock-drills. Local labour will be employed although supervision and certain operations will be carried out by men already sent from Camborne. The factory is expected to be in full work by the end of June.

William Boby and Co., Ltd., of 62–64, Brook Street, London, W. 1, have prepared a leaflet describing their precipitation plant on the Andrews system, to which attention was first directed under the heading of this company's exhibit at the British Industries Fair. The same principle underlies the operation of this plant as that incorporated in the Andrews hydraulic classifier marketed by Kinetic Elutriators, Ltd. It is also applied to water-softening plant, by means of which a larger continuous output of softened water is obtained with a considerably reduced amount of attendance. The ejection of the sludge is effected automatically by means of the under-current valve mechanism, which is similar in principle to the sand-gate mechanism of the hydraulic classifier already referred to.

Westinghouse Electric International Co., of 2, Norfolk Street, Strand, London, W.C. 2 (head office: New York), have issued their customary publication describing engineering achievements during the year 1932. This includes sections on turbine work, transformers, lightning protection, metal-clad switchgear, air conditioning, new motors for special drives, electric heating, instruments, lighting, and winding engines. The last-named gives particulars of new installations, notably those at Noranda and Lake Shore. The first is briefly described as being a winding engine with a 1,550-h.p., 650-volt, 68-r.p.m., d.c. motor, taking power from a 1,800-h.p., 25-cycle, 2,200-volt, 750-r.p.m. synchronous motor generator. The shaft is 4,200 ft. deep and loads of 12,000 lb. of ore in a 10,000 lb. skip or bucket come up at 2,200 ft. per min. The second is for raising ore from a depth of 4,100 ft., the capacity of the skip being the same as before. The hoist is driven by a motor virtually a duplicate of that at Noranda, but operating at a lower voltage (600 volts) and speed (63 r.p.m.), and has thus a lower rating (1,350 h.p.). The power supply is from a motor generator set driven by a 1,500-h.p., 25-cycle, 2,200-volt induction motor, with a steel plate flywheel for 80% equalization and a liquid slip regulator.

Alfred Herbert, Ltd., of Coventry, have published a pamphlet describing dust and sulphur removal plant for handling furnace gases known as the Modave dust arrester, to which attention was first directed here under the heading of this company's exhibit at the British Industries Fair. The apparatus consists of an upper tank connected with the water supply, and the action is as follows:—Water flows through valve V. 1 into tank R and fills elements E, overflows and runs down the sides of the elements into tank B. The gases enter the apparatus at right angles to the axes of the elements. As the dust particles come into contact with the wet surfaces of the elements they are washed down into the tank B, where they are carried away by the water which passes out of the apparatus by valve V. 2. This valve is adjusted so that a trickle



Modave Dust Arrester

of water is issuing from the overflow T. The water charged with dust is run either to waste or settling ponds where the dust is precipitated. In the case of sulphurous gases it is necessary to mix lime or some other alkali with the water supplied to the dust arrester to assist the absorption of the oxides of sulphur and to neutralize the acid which is formed. A complete sulphur removal plant consists of the plant for intermittent mixing of the alkali with the water, a Modave dust arrester, and a sludge precipitation plant, such as that referred to under the heading of William Boby and Co., Ltd., in a paragraph in this issue. Such an installation is quite self-contained, the water being continuously circulated round the system and the amount of make-up water that is required is very small.

METAL MARKETS

Copper.—During April the United States again affected the non-ferrous metal markets, including copper, by surprise developments. Whereas March was characterized by the American banking moratorium, April saw the abandonment of the gold standard by the United States. This resulted in a soaring of the cent price of copper, which rose from 5 cents per lb. (both c.i.f. Europe for export and delivered Connecticut Valley for internal consumption) to 6·05 cents c.i.f. Europe and 6·50 cents delivered respectively. The standard market was favourably affected by America's movement towards inflation, though it remains to be seen whether this will prove justified, particularly as the suggested general United States mining shut-down may not now take place. Considerable investment buying of copper has been seen.

Average price of Cash Standard Copper: April, 1933, £29 12s. 5d.; March, 1933, £28 4s. 4d.; April, 1932, £29 19s. 10d.; March, 1932, £33 1s. 9d.

Tin.—Prices experienced a heavy rise during April, mainly on sustained American buying. So heavy was this purchasing that fears are entertained in some quarters that the market may be somewhat "overbought." The statistical position, however, continues to develop favourably. Producers have agreed to keep production at 33⅓% of the 1929 basic rate when the present arrangements expire at the end of June. The International Tin Pool cannot commence to release its tin until the rate of output is raised to 40%, although prices are now close to its authorized initial release price of £165.

Average price of Cash Standard Tin: April, 1933, £158 0s. 4d.; March, 1933, £149 4s. 1d.; April, 1932, £109 0s. 10d.; March, 1932, £129 18s. 2d.

Lead.—The tone of this market has also been assisted by transatlantic developments. Apart from the tendency for American investors and consumers to put cash reserves into lead holdings, there is a feeling that if inflation definitely occurs in the United States this will result in a considerable stimulation as regards the tempo of industry generally. In such circumstances the mild strength displayed by lead prices has been understandable. European conditions have not undergone much change so far and international trade has been considerably disturbed by the erratic behaviour of the dollar.

Average mean price of soft foreign lead: April, 1933, £10 19s. 11d.; March, 1933, £10 14s. 3d.; April, 1932, £11 7s. 3d.; March, 1932, £12 9s. 9d.

Spelter.—This market naturally did not escape the repercussions of the American monetary sensation and "inflation buying" on the other side of the Atlantic helped to harden prices here also. The statistical position in the United States is still very discouraging, but, of course, stocks over there ought to begin to diminish if industry picks up on a big scale as optimists hope will be the case. The spelter situation outside the United States continues to improve.

Average mean price of spelter: April, 1933, £15 1s. 7d.; March, 1933, £14 13s. 2d.; April, 1932, £11 16s. 3d.; March, 1932, £12 16s. 4d.

Iron and Steel.—The British pig-iron market remained quite cheerful last month. Cleveland prices were unchanged, No. 3 foundry g.m.b. for local delivery remaining at 62s. 6d. delivered. Much lower figures were accepted, however, for export. Hematite was moderately active and stocks of this material appear to have ceased to expand. East Coast mixed numbers are priced around 59s. f.o.t. or f.o.b. In the finished steel market sentiment was improved by various factors, including big L.M.S. Railway allotments of rails, foreign rail and bridge orders, and the Anglo-Danish trade agreement, but demand from the shipyards is slow to expand. The market for Continental steel was disturbed by the American abandonment of the gold standard, whilst towards the end of the month most works on the other side of the Channel withdrew in view of the imminent establishment of the international sales offices, which will fix prices.

Iron Ore.—Although the outlook improved slightly during April and some moderate purchases were made, the aggregate turnover remains comparatively small, especially in Germany. Prices are rather nominal based on 15s. 3d. to 15s. 6d. per ton c.i.f. for best Bilbao rubio.

Antimony.—The market has been thoroughly unsettled by the rapid and wide fluctuations in silver prices, which have affected the Chinese exchange.

LONDON DAILY METAL PRICES.

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

	COPPER.			TIN.		ZINC (Spelter).	LEAD.		SILVER.		GOLD.
	Standard		Electrolytic	Best Selected.			Soft Foreign.	English.	Cash.	Forward.	
	Cash.	3 Months.			Cash.	3 Months.					
Apr.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	s. d.
11	30 0 7½	30 4 4½	34 17 6	32 10 0	156 8 9	157 2 6	14 17 6	11 0 0	12 10 0	17 11/16	18	121 4
12	29 17 6	30 0 7½	34 10 0	—	156 11 3	157 6 3	14 17 6	10 17 6	12 10 0	17 5/8	17 11/16	121 8
13	29 6 10½	29 11 10½	34 0 0	31 15 0	156 13 9	157 7 6	14 15 0	10 15 0	12 5 0	18	18 1/16	121 6
18	29 3 9	29 7 6	33 15 0	31 15 0	157 16 3	158 11 3	14 15 0	11 0 0	12 10 0	17 11/16	18	120 9½
19	29 3 9	29 8 9	33 10 0	—	158 8 9	159 1 3	15 2 6	11 0 0	12 10 0	18 1/16	18 7/16	120 2
20	29 15 7½	29 19 4½	33 17 6	—	159 8 9	159 17 6	15 6 3	11 2 6	12 10 0	19 3/16	19¼	120 6
21	30 6 3	30 10 7½	34 10 0	32 15 0	160 13 9	161 7 6	15 8 9	11 7 6	12 15 0	19½	19 5/16	119 1
24	30 3 1½	30 8 1½	34 10 0	—	160 6 3	161 1 3	15 3 9	11 2 6	12 10 0	20 1/16	20 5/16	118 2
25	30 8 9	30 11 10½	34 17 6	32 15 0	162 18 9	163 12 6	15 6 3	11 1 3	12 10 0	20 1/16	20½	119 0
26	30 15 7½	30 18 1½	35 2 6	—	164 1 3	164 13 9	15 6 3	11 3 9	12 10 0	18½	18 5/16	121 0
27	30 15 0	30 16 10½	35 6 3	—	164 11 3	165 3 9	15 3 9	11 0 0	12 10 0	20 1/16	20¼	121 4
28	30 10 7½	30 13 1½	35 2 6	33 0 0	164 8 9	165 1 3	15 1 3	11 1 3	12 10 0	20	20	122 6
May.												
1	30 19 4½	31 0 7½	35 0 0	—	171 2 6	171 15 0	14 16 3	10 18 9	12 10 0	20½	20 5/16	123 9
2	31 4 4½	31 5 7½	35 10 0	33 10 0	173 8 9	174 1 3	14 18 9	11 1 3	12 10 0	20½	20¼	124 8
3	31 5 7½	31 8 1½	35 10 0	—	173 17 6	174 8 9	14 16 3	11 1 3	12 10 0	19 7/16	19½	123 5
4	32 6 3	32 8 9	36 0 0	—	177 7 6	177 18 9	14 18 9	11 7 6	12 15 0	19 3/8	19 7/16	124 6
5	32 15 7½	33 0 7½	36 11 3	35 0 0	178 15 0	179 7 6	15 2 6	11 17 6	13 5 0	19¼	19 5/16	124 8
8	32 16 10½	33 0 7½	36 12 6	—	182 3 9	183 2 6	15 7 6	12 1 3	13 10 0	19 5/8	19½	123 9
9	33 8 1½	33 11 10½	37 5 0	35 15 0	182 11 3	183 6 3	15 8 9	12 0 0	13 10 0	19 5/16	19 3/8	123 4
10	33 1 10½	33 7 6	37 5 0	—	182 11 3	183 2 6	15 2 6	11 16 3	13 5 0	18 15/16	19	123 4

Business has been slow and quotations are now somewhere about £22 10s. to £23 c.i.f. for forward shipment from China and £37 10s. to £42 10s. delivered for English.

Arsenic.—The uncertain value of the dollar has made Mexican arsenic rather nominal, but about £18 to £18 5s. c.i.f. is still quoted. Cornish white is about £19 f.o.r. mines.

Bismuth.—The official price has continued unchanged at 4s. 6d. per lb. for 5 cwt. lots and over.

Cadmium.—Business is not on a very large scale, and prices are fractionally easier at about 1s. 5d. per lb.

Cobalt Metal.—The easiness of the dollar in the latter half of April led to prices being reduced officially to 5s. 6d. per lb. for cwt. lots.

Cobalt Oxides.—Current quotations are about 4s. 9d. to 5s. 2d. per lb. for black and 5s. 4d. to 5s. 7d. for grey.

Chromium.—The market is steady at 2s. 9d. per lb. delivered for 96 to 98%.

Tantalum.—Round about £15 per lb. is still quoted, but demand is of little commercial importance.

Platinum.—The undertone of the market remained fairly good during April, business having been on a rather better scale recently. Officially the price of refined metal remains at £7 10s. per oz.

Palladium.—Business is slow and current quotations are about £3 10s. to £4 5s. per oz.

Osmium.—In the absence of any selling pressure quotations are upheld at £12 to £12 10s. per oz.

Iridium.—Sponge and powder are still quoted at £9 10s. per oz., but there is not a great deal moving.

Tellurium.—Somewhere about 17s. 6d. per lb. is the current value.

Selenium.—Business continues steadily at the unaltered prices of 7s. 8d. to 7s. 9d. per lb. (gold) ex warehouse Liverpool.

Manganese Ore.—This market presents few new features of interest. Russia occasionally disposes of a little, whilst India also sells odd cargoes to the Continent. Generally speaking, however, the demand is very slow and prices are quotably unchanged at 9½d. per unit c.i.f. for best Indian and 8½d. to 9d. c.i.f. for 50 to 52% washed Caucasian.

Aluminium.—There is a quietly steady demand at the unaltered prices of £100 for ingots and bars and £102 for rolling billets, both less 2% delivered.

Sulphate of Copper.—About £15 5s. to £15 15s., less 5%, is quoted for British material.

Nickel.—Although it was thought at one time that the easiness of the dollar would result in lower sterling prices, so far there has been no change, £240 to £245 per ton still being quoted, according to quantity. Demand recently has been rather better.

Chrome Ore.—There is nothing much moving, but prices are steady at 80s. to 85s. per ton c.i.f. for good 48% Rhodesian ore and 100s. to 105s. c.i.f. for 55 to 57% New Caledonian.

Quicksilver.—Now and then some fair orders are placed, but on the whole the market is quietly steady, with spot metal about £9 15s. per bottle, net.

Tungsten Ore.—Like other China products the value of tungsten ore has been very indefinite, owing to the uncertainty of silver. Probably about 10s. 6d. to 10s. 9d. per unit c.i.f. represents the current value of forward shipment from China.

Molybdenum Ore.—With rather more material offering prices have eased to about 45s. per unit c.i.f. for 80 to 85% concentrates.

Graphite.—Business is rather slow and prices continue largely nominal at about £16 to £18 per ton c.i.f. for 85 to 90% raw Madagascar flake and £15 to £17 c.i.f. for 90% Ceylon lumps.

Silver.—The silver market during April underwent some wide fluctuations and considerable changes in outlook. The abandonment of the gold standard by the United States was the outstanding feature since, coupled with talk of inflation with special measures for raising silver prices, it resulted in considerable speculative buying. This continued on and off to the end of the month, but occasional realizing brought some sharp reactions at times. Spot bars after standing at 17 7/16d. on April 1 rose to 20 7/16d. on April 25 and closed at 19⅞d. on April 29.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
April, 1932	901,894	47,902	949,796
May	919,223	46,421	965,644
June	913,297	45,714	959,011
July	933,947	47,213	981,160
August	943,174	48,148	991,322
September	912,870	48,631	961,501
October	926,686	48,279	974,965
November	930,085	48,631	978,716
December	931,749	48,869	980,618
January, 1933	919,125	48,332	967,457
February	835,931	47,214	883,145
March	896,728	50,135	946,863
April	845,099	49,998	895,097

TRANSVAAL GOLD OUTPUTS.

	March.		April.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	114,500	£211,780	114,000	£214,492
City Deep	89,000	22,531	80,000	20,108
Cons. Main Reef	77,000	24,290	77,100	23,911
Crown Mines	291,000	88,790	274,000	83,648
Daggafontein	46,000	£114,611	49,500	£116,109
D'rb'n Roodepoort Deep	52,000	14,561	48,900	13,682
East Geduld	69,000	23,466	63,500	21,597
East Rand P.M.	164,000	41,000	156,000	39,093
Geduld	88,000	27,201	86,600	26.769
Geldenhuis Deep	76,500	15,849	72,500	14,980
Glynn's Lydenburg	7,760	2,493	7,400	2,603
Government G.M. Areas	215,000	£555,421	190,000	£486,004
Kleinfontein	53,800	10,100	51,000	9,481
Langlaagte Estate	82,000	£137,113	70,000	£122,980
Luipaard's Vlei	36,000	8,299	34,100	8,106
Modderfontein New	178,000	53,425	168,000	50,431
Modderfontein B	77,500	17,553	73,000	16,557
Modderfontein Deep	46,000	19,746	42,400	18,240
Modderfontein East	78,000	20,812	72,500	18,928
New State Areas	94,000	£267,855	85,000	£246,258
Nourse	72,000	18,678	70,000	18,352
Randfontein	260,000	£428,905	245,000	£394,218
Robinson Deep	100,000	27,023	95,000	25,696
Rose Deep	64,000	12,341	60,500	11,641
Simmer and Jack	90,200	21,096	85,000	20,133
Springs	82,000	£217,918	82,700	£220,936
Sub Nigel	38,000	35,519	36,900	35,382
Transvaal G.M. Estates	20,100	5,480	20,000	5,223
Van Ryn	52,000	£63,601	50,000	£60,883
Van Ryn Deep	78,000	£130,666	70,000	£120,274
West Rand Consolidated	98,000	£149,557	95,000	£144,031
West Springs	82,500	£107,961	83,300	£107,774
Witw'tersr'nd (Knights)	69,000	£71,660	69,000	£67,402
Witwatersrand Deep	47,000	15,722	44,300	14,622

Gold at 119s. per oz.

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.	£
January, 1932	2,880,500	27 5	19 4	8 1	1,163,434
February	2,775,400	27 8	19 6	8 2	1,133,212
March	2,901,300	27 10	19 7	8 3	1,200,278
April	2,883,500	27 9	19 5	8 4	1,196,011
May	2,964,100	27 6	19 2	8 4	1,228,198
June	2,927,200	27 9	19 3	8 6	1,241,392
July	2,993,600	27 5	19 0	8 5	1,260,744
August	3,027,700	27 6	19 1	8 5	1,277,923
September	2,940,800	27 6	19 1	8 5	1,234,584
October	2,994,500	27 5	19 0	8 5	1,263,274
November	2,949,050	27 8	19 2	8 6	1,256,717
December	2,972,000	27 10	19 5	8 5	1,255,797
January, 1933	3,029,000	27 10	19 4	18 6	2,802,754
February	2,802,600	37 0	19 9	17 3	2,414,758
March	—	—	—	—	2,549,179

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
April 30, 1932	214,334	11,943	—	226,277
May 31	215,926	11,972	—	227,898
June 30	217,077	11,833	—	228,910
July 31	217,525	12,056	—	229,581
August 31	217,658	11,727	—	229,385
September 30	216,398	11,642	—	228,040
October 31	216,298	11,353	—	227,651
November 30	219,024	11,207	—	230,231
December 31	221,008	11,310	—	232,318
January 31, 1933	222,005	11,292	—	233,297
February 28	222,589	11,472	—	234,061
March 31	223,490	11,626	—	235,116
April 30	225,279	11,611	—	236,890

PRODUCTION OF GOLD IN RHODESIA.

	1930	1931	1932	1933
	oz.	oz.	oz.	oz.
January	46,121	45,677	42,706	48,656
February	43,385	42,818	45,032	47,661
March	45,511	42,278	47,239	49,929
April	45,806	43,776	46,487	—
May	47,645	43,731	46,854	—
June	45,208	44,118	48,441	—
July	45,810	44,765	47,331	—
August	46,152	43,292	49,254	—
September	46,151	42,846	50,198	—
October	45,006	44,260	50,416	—
November	44,351	44,516	48,082	—
December	46,485	50,034	52,096	—

RHODESIAN GOLD OUTPUTS.

	March.		April.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	25,600	9,527	25,600	9,523
Globe and Phœnix	6,092	5,542	6,096	5,493
Lonely Reef	11,000	2,130	11,000	2,102
Luiri Gold	—	—	—	—
Rezende	6,500	2,506	6,500	2,397
Sherwood Star	6,400	£8,065	6,400	£7,837
Wanderer Consolidated	15,900	3,672	13,200	3,566

WEST AFRICAN GOLD OUTPUTS.

	March.		April.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	6,479	£20,581	6,608	£20,864
Ashanti Goldfields	13,490	14,740	13,448	14,739
Taquah and Abosso	10,493	3,461	10,038	3,282

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.
	Oz.	Oz.	Oz.
April, 1932	48,936	—	1,216
May	53,928	—	692
June	50,079	—	920
July	53,585	—	1,391
August	51,536	—	1,026
September	54,427	—	1,160
October	51,236	—	2,169
November	53,956	38,612†	4,386
December	52,282	9,133	4,602
January, 1933	45,755	—	4,005
February	47,281	—	4,365
March	47,105	—	—
April	52,909	—	—

† Period Jan.–Nov. 1932.

AUSTRALASIAN GOLD OUTPUTS.

	March.		April.	
	Tons.	Value £	Tons.	Value £
Associated G.M. (W.A.)	5,477	5,732	5,101	4,456
Blackwater (N.Z.)	3,860	1,823*	3,200	1,637*
Boulder Persev'ce (W.A.)	7,211	14 069	6,712	13,261
Grt. Boulder Pro. (W.A.)	7,476	5,527*	6,942	5,174*
Lake View & Star (W.A.)	40,467	72,907	—	—
Sons of Gwalia (W.A.)	12,104	16,055	11,550	15,430
South Kalgurli (W.A.)	10,124	15,322	9,341	13,766
Waihi (N.Z.)	18,797‡	{ 5,972* / 30,992†	16,893‡‡	{ 5,046* / 28,866†
Wiluna	33,062	8,690*	—	—

* Oz. gold. † Oz. silver. ‡ Mar. 18. ‡‡ To Apr. 15.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	March.		April.	
	Tons Ore.	Total Oz.	Tons Ore.	Total Oz.
Champion Reef	9,400	5,564	8,580	4,904
Mysore	14,865	7,705	14,375	7,425
Nundydroog	19,481	12,811*	18,575	11,754†
Ooregum	11,765	4,221	11,752	4,200

* 1,127 oz. from 1,130 tons Balaghat ore. † 1,273 oz. from 1,146 tons Balaghat ore.

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	March.		April.	
	Tons.	Value £	Tons.	Value £
Bulolo Gold	—	148,898*d*	—	153,271*d*
Chosen Corp. (Korea)	10,060	17,850	—	—
Frontino Gold (C'lbia)	4,370	19,990	4,450	26,184
Fresnillo	78,237	759*d*	—	—
New Goldfields of Venezuela	8,527	2,324*	8,192	2,017*
Oriental Cons. (Korea)	—	67,465*d*	—	80,370*d*
St. John del Rey (Brazil)	—	38,500	—	42,200
Santa Gertrudis (Mexico)	19,841	3,884*d*‡	—	—
Viborita	—	—	—	—
West Mexican Mines	1,160	17,000*d*	—	—

d Dollars. * Oz. gold. ‡ Loss.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

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

July, 1932	1,437	January, 1933	2,312
August	1,164	February	2,154
September	1,123	March	1,506
October	2,273	April	2,589
November	2,242	May	—
December	1,590	June	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	Feb.	Mar.	Apr.
Ayer Hitam	—	—	68½
Batu Caves	27	—	—
Changkat	60	55	60
Gopeng	—	72½*	—
Hongkong Tin	—	105*	—
Idris Hydraulic	18	—	20⅜
Ipoh	55¼	—	54¾
Kampar Malaya	—	—	—
Kampong Lanjut	—	—	—
Kamunting	—	173	145
Kent (F.M.S.)	—	—	—
Killinghall	—	86¾*	—
Kinta	—	34½*	—
Kinta Kellas	—	38⅓*	36½
Kramat Tin	76	78	85
Kuala Kampar	—	—	—
Kundang	—	—	—
Lahat	11	7¼	12½
Lower Perak	—	—	—
Malaya Consolidated	—	—	—
Malayan Tin	81	—	68½
Malim Nawar	—	—	—
Pahang	78	78	72
Penawat	48½	39	45
Pengkalen	—	67*	—
Petaling	—	151	152
Rahman	25	—	23
Rambutan	—	—	—
Rantau	21	—	—
Rawang	33	42	23
Rawang Concessions	29	16	23
Renong	25¼	23½	27
Selayang	—	—	—
Southern Kampar	78½	—	75
Southern Malayan	53¼	51¼	53½
Southern Perak	15⅔	—	51
Southern Tronoh	18	18	17
Sungei Besi	—	—	—
Sungei Kinta	—	—	—
Sungei Way	53½	—	56½
Taiping	9	11½	—
Tanjong	—	—	—
Tekka	—	39*	—
Tekka Taiping	—	65*	—
Temoh	—	—	—
Tronoh	39	39	37
Ulu Klang	—	—	—

* 3 months to Mar. 31.

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Feb.	Mar.	Apr.
Anglo-Nigerian	18	17½	17½
Associated Tin Mines	100½	106	110
Baba River	3	3	3
Batura Monguna	—	—	—
Bisichi	20	20	—
Daffo	—	—	—
Ex-Lands	—	—	—
Filani	—	—	—
Jantar	10	9	12
Jos	7⅞	7¾	—
Juga Valley	5⅛	5½	5½
Kaduna Syndicate	11	11	11
Kaduna Prospectors	6	5	6
Kassa	3	3	3
London Tin	76	75	86
Lower Bisichi	3	3	—
Naraguta Extended	—	—	—
Nigerian Consolidated	5	—	5
Offin River	—	—	—
Ribon Valley	9	10	9½
Tin Fields	—	—	—
United Tin Areas	9	9	9
Yarde Kerri	—	—	—

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Feb.	Mar.	Apr.
Anglo-Burma (Burma)	23	23	21¾
Aramayo Mines (Bolivia)	123	99	108
Bangrin (Siam)	—	51½	61½
Beralt	24*	24*	24*
Consolidated Tin Mines (Burma)	82	73	72
East Pool (Cornwall)	45	47¼	44
Fabulosa (Bolivia)	34	37	32
Geevor	—	55	52
Kagera (Uganda)	21	25	—
Kamra	—	—	—
Malaysiam Tin	14¼	14¼	13½
Mawchi	218*	225*	—
Patino	—	—	—
Pattani	—	—	—
San Finx (Spain)	—	—	—
Siamese Tin (Siam)	—	118½	140
South Crofty	49½	51¼	52
Tavoy Tin (Burma)	38¼	47½	45½
Tongkah Harbour (Siam)	50	35	32
Toyo (Japan)	54½	68½	71
Zaaiplaats	13½	—	—

* Tin and Wolfram.

COPPER LEAD, AND ZINC OUTPUTS.

		Mar.	Apr.
Britannia Lead	Tons refined lead	3,318	—
	Oz. refined silver	217,204	—
Broken Hill South	Tons lead conc.	5,552‡	4,507
	Tons zinc conc.	6,425‡	5,047
Burma Corporation	Tons refined lead	5,880	5,880
	Oz. refined silver	520,975	500,755
Electrolytic Zinc	Tons zinc	—	—
Indian Copper	Tons copper	400	400
	Tons yellow metal	460	470
Messina	Tons copper	796	684
Mount Isa	Tons lead bullion	5,215	—
Mount Lyell	Tons concentrates	2,313†	2,777*
North Broken Hill	Tons lead conc.	4,900	4,850
	Tons zinc conc.	4,790	4,298
Rhodesia Broken Hill	Tons Zinc	1,550	1,680
	Tons V_2O_5 conc.	20	—
Roan Antelope	Tons blister copper	—	—
Sulphide Corporation	Tons lead conc.	1,488‡	—
	Tons zinc conc.	2,115‡	—
Trepca	Tons lead conc.	4,952	3,626
	Tons zinc conc.	6,721	4,638
Zinc Corporation	Tons lead conc.	5,848‡	—
	Tons zinc conc.	4,047‡	—

* To Apr. 19. † To March 22. ‡ To Apr. 8.

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

		Feb.	Mar.
Iron Ore	Tons	210,635	218,261
Manganese Ore	Tons	4,929	5,982
Iron and Steel	Tons	77,959	96,963
Copper and Iron Pyrites	Tons	30,666	24,099
Copper Ore, Matte, and Prec.	Tons	3,103	1,090
Copper Metal	Tons	8,634	10,113
Tin Concentrate	Tons	1,313	3,145
Tin Metal	Tons	320	755
Lead Pig and Sheet	Tons	19,835	20,059
Zinc (Spelter)	Tons	5,631	5,076
Zinc Sheets, etc.	Tons	1,111	1,547
Zinc Oxide	Tons	21	72
Zinc Ore and Conc.	Tons	2,126	—
Aluminium	Cwt.	5,012	9,294
Mercury	Lb.	135,743	73,100
White Lead	Cwt.	5,158	6,183
Barytes, ground	Cwt.	25,092	25,677
Asbestos	Tons	910	1,539
Boron Minerals	Tons	1,004	1,719
Borax	Cwt.	7,700	15,720
Basic Slag	Tons	1,000	—
Superphosphates	Tons	4,245	8,927
Phosphate of Lime	Tons	20,919	19,070
Mica	Tons	130	102
Tungsten Ores	Tons	296	339
Sulphur	Tons	5,667	5,813
Nitrate of Soda	Cwt.	120	—
Potash Salts	Cwt.	128,077	280,039
Petroleum: Crude	Gallons	25,157,778	25,254,908
Lamp Oil	Gallons	17,360,876	19,467,893
Motor Spirit	Gallons	66,960,656	116,014,311
Lubricating Oil	Gallons	3,265,040	9,878,865
Gas Oil	Gallons	8,862,734	7,342,402
Fuel Oil	Gallons	46,168,593	50,356,989
Asphalt and Bitumen	Tons	9,251	7,924
Paraffin Wax	Cwt.	90,925	67,806

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES.

In Tons.

	Feb.	Mar.	Apr.
Anglo-Ecuadorian	14,780	16,011	15,024
Apex Trinidad	44,500	49,030	47,990
Attock	1,259	1,421	1,242
British Burmah	4,241	5,091	5,225
British Controlled	41,870	39,599	37,945
Kern Mex	760	857	857
Kern River (Cal.)	3,244	7,429*	3,187
Kern Romana	74	140	207
Kern Trinidad	2,641	3,099	3,937
Lobitos	20,290	21,454	21,614
Phœnix	59,338	65,388	63,255
St. Helen's Petroleum	3,795	—	3,797
Steaua Romana	81,733	90,399	—
Tampico	2,091	2,437	2,378
Tocuyo	1,073	1,153	1,042
Trinidad Leaseholds	28,600	31,650	32,450

* Includes St. Helen's Petroleum.

QUOTATIONS OF OIL COMPANIES' SHARES.

Denomination of Shares £1 unless otherwise noted.

	Apr. 8, 1933.	May 10, 1933.
	£ s. d.	£ s. d.
Anglo-Ecuadorian	11 0	11 0
Anglo-Egyptian B	1 10 0	1 11 9
Anglo-Persian 1st Pref.	1 7 3	1 6 3
,, ,, Ord.	1 18 0	1 15 0
Apex Trinidad (5s.)	1 3 9	1 3 6
Attock	10 0	10 0
British Burmah (8s.)	4 3	4 3
British Controlled ($5)	4 3	6 0
Burmah Oil	2 18 9	3 1 3
Kern River Cal. (10s.)	3 0	2 6
Lobitos, Peru	1 15 0	1 16 9
Mexican Eagle, Ord. (4 pesos)	6 9	7 0
,, ,, 8% Pref. (4 pesos)	5 9	6 9
Phœnix, Roumanian	10 0	10 0
Royal Dutch (100 fl.)	16 15 0	19 0 0
Shell Transport, Ord.	2 3 0	2 6 9
,, ,, 5% Pref. (£10)	11 7 6	11 10 0
Steaua Romana	9 6	8 6
Trinidad Leaseholds	2 13 9	2 16 3
United British of Trinidad (6s. 8d.)	4 9	5 6
V.O.C. Holding	1 11 3	1 13 0

PRICES OF CHEMICALS. May 9.

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

		£ s. d.
Acetic Acid, 40%	per cwt.	1 0 9
,, ,, 80%	,,	1 18 5
,, ,, Glacial	per ton	59 0 0
Alum	,,	8 7 6
Aluminium Sulphate, 17 to 18%	,,	6 15 0
Ammonium, Anhydrous	per lb.	1 1
,, 0·880 solution	per ton	15 10 0
,, Carbonate	,,	27 10 0
,, Nitrate (British)	,,	16 0 0
,, Phosphate (Mono- and Di-)	,,	58 0 0
,, Sulphate, 20·6% N.	,,	6 10 0
Antimony, Tartar Emetic, 43/44%	per lb.	10
,, Sulphide, golden	,,	9
Arsenic, White (foreign)	per ton	20 0 0
Barium, Carbonate (native), 94%	,,	4 10 0
,, ,, Chloride	,,	10 10 0
Barytes	,,	8 5 0
Benzol, standard motor	per gal.	1 6½
Bleaching Powder, 35% Cl.	per ton	8 15 0
Borax	,,	16 10 0
Boric Acid	,,	26 10 0
Calcium Chloride, solid, 70/75%	,,	5 5 0
Carbolic Acid, crude 60's	per gal.	3 0
,, ,, crystallized, 40°	per lb.	11
Carbon Disulphide	per ton	30 0 0
Citric Acid	per lb.	9½
Copper Sulphate	per ton	14 15 0
Creosote Oil (f.o.b. in Bulk)	per gal.	3½
Cresylic Acid, 98-100%	,,	1 2
Hydrofluoric Acid, 59/60%	per lb.	6
Iodine Resub. B.P. (28 lb. lots)	,,	14 11
Iron, Nitrate 80° Tw.	per ton	6 0 0
,, Sulphate	,,	1 15 0
Lead, Acetate, white	,,	31 10 0
,, Nitrate (ton lots)	,,	27 10 0
,, Oxide, Litharge	,,	25 10 0
,, White	,,	37 10 0
Lime, Acetate, brown	,,	9 10 0
,, ,, grey, 80%	,,	14 10 0
Magnesite, Calcined	,,	9 10 0
Magnesium Chloride	,,	6 10 0
,, Sulphate, comml.	,,	5 0 0
Methylated Spirit Industrial 61 O.P.	per gal.	2 0
Nitric Acid, 80° Tw.	per ton	21 10 0
Oxalic Acid	per ton	48 0 0
Phosphoric Acid. (Conc. 1·750)	per lb.	10
Pine Oil	per cwt.	2 7 6
Potassium Bichromate	per lb.	5
,, Carbonate, 96/98%	per ton	32 0 0
,, Chlorate	per lb.	4
,, Chloride, 80%	per ton	9 10 0
,, Ethyl Xanthate	per 100 kilos	7 8 0
,, Hydrate (Caustic) 88/90%	per ton	40 0 0
,, Nitrate	,,	30 0 0
,, Permanganate	per lb.	8½
,, Prussiate, Yellow	per ton	75 0 0
,, ,, Red	per lb.	2 0
,, Sulphate, 90%	per ton	10 10 0
Sodium Acetate	,,	22 10 0
,, Arsenate, 45%	,,	23 0 0
,, Bicarbonate	,,	10 10 0
,, Bichromate	per lb.	4
,, Carbonate (Soda Ash), 58%	per ton	6 0 0
,, ,, (Crystals)	,,	5 2 6
,, Chlorate	,,	32 0 0
,, Cyanide, 100% NaCN basis	per lb.	8
,, Ethyl Xanthate	per 100 kilos	7 0 6
,, Hydrate, 76/77%	per ton	14 0 0
,, Hyposulphite, comml.	,,	9 2 6
,, Nitrate (refined)	,,	8 10 0
,, Phosphate, comml.	,,	12 0 0
,, Prussiate	per lb.	4½
,, Silicate	per ton	9 10 0
,, ,, (liquid, 140° Tw.)	,,	8 10 0
,, Sulphate (Glauber's Salt)	,,	2 15 0
,, ,, (Salt-Cake)	,,	3 1 0
,, Sulphide, Conc., 60/65%	,,	10 15 0
,, Sulphite, pure	per cwt.	14 0
Sulphur, Flowers	per ton	9 10 0
,, Roll	,,	9 10 0
Sulphuric Acid 168° Tw.	,,	4 5 0
,, ,, free from Arsenic, 140° Tw.	,,	3 0 0
Superphosphate of Lime (S.P.A. 16%)	,,	3 4 0
Tartaric Acid	per lb.	11½
Turpentine	per ton	62 10 0
Tin Crystals	per lb	1 0
Titanous Chloride	,,	10½
Zinc Chloride	per ton	9 10 0
,, Dust, 90/92%	,,	20 0 0
,, Oxide (White Seal)	,,	35 0 0
,, Sulphate	,,	9 0 0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

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

COPPER:		
Bwana M'Kubwa (5s.), Rhodesia	5 0	5 3
Esperanza	6 3	6 3
Indian (2s.)	1 9	1 9
Loangwa (5s.), Rhodesia	1 9	1 6
Mason and Barry	11 3	11 3
Messina (5s.), Transvaal	7 0	8 3
Mount Lyell, Tasmania	15 3	18 3
Namaqua (£2), Cape Province	3 6	3 6
Rhodesia-Katanga	10 0	10 0
Rio Tinto (£5), Spain	14 15 0	17 10 0
Roan Antelope (5s.), Rhodesia	14 9	18 9
Tanganyika Concessions	16 9	14 3
Tharsis (£2), Spain	2 18 9	3 7 6

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

TIN:		
Aramayo Mines (25 fr.), Bolivia	11 3	16 3
Associated Tin (5s.), Nigeria	4 3	6 0
Ayer Hitam (5s.), Malay	11 6	13 0
Bangrin, Siam	11 6	17 0
Bisichi (10s.), Nigeria	5 3	7 0
Consolidated Tin Mines of Burma	2 9	3 6
East Pool (5s.), Cornwall	9	1 2
Ex-Lands Nigeria (2s.)	1 0	1 9
Geevor (10s.), Cornwall	3 0	5 3
Gopeng, Malay	1 7 6	1 12 6
Hongkong (5s.), Malay	12 0	14 3
Idris (5s.), Malay	5 0	6 6
Ipoh Dredging (10s.), Malay	14 3	1 1 0
Kaduna Prospectors (5s.), Nigeria	5 0	5 0
Kaduna Syndicate (5s.), Nigeria	11 3	13 9
Kamunting (5s.), Malay	6 6	9 0
Kepong, Malay	6 3	7 6
Kinta (5s.), Malay	4 0	6 3
Kinta Kellas (5s.), Malay	4 0	5 0
Kramat Pulai, Malay	14 6	18 9
Kramat Tin, Malay	1 8 6	1 8 6
Lahat, Malay	—	—
Malayan Tin Dredging (5s.)	17 9	1 1 6
Naraguta, Nigeria	8 9	10 0
Pahang Consolidated (5s.), Malay	4 3	6 6
Penawat ($1), Malay	1 0	1 6
Pengkalen (5s.), Malay	7 6	9 0
Petaling (2s. 4d.), Malay	10 6	12 9
Rambutan, Malay	4 0	5 0
Renong Dredging, Malay	14 6	1 0 6
Siamese Tin (5s.), Siam	8 6	12 3
South Crofty (5s.), Cornwall	2 0	3 6
Southern Malayan (5s.)	10 9	12 0
Southern Perak, Malay	1 5 0	1 6 3
Southern Tronoh (5s.), Malay	4 6	6 3
Sungei Besi (5s.), Malay	9 0	10 9
Sungei Kinta, Malay	8 9	11 3
Tanjong (5s.), Malay	5 6	8 0
Tavoy (4s.), Burma	4 3	5 3
Tekka, Malay	8 0	9 3
Tekka Taiping, Malay	8 0	10 6
Temoh, Malay	10 0	14 0
Toyo (2s. 6d.), Japan	2 6	3 0
Tronoh (5s.), Malay	14 3	16 6

DIAMONDS:		
Consol. African Selection Trust (5s.)	15 6	18 9
Consolidated of S.W.A. (10s.)	5 3	5 9
De Beers Deferred (£2 10s.)	4 11 3	5 1 3
Jagersfontein	1 2 6	1 5 0
Premier Preferred (5s.)	1 2 6	2 0 0

FINANCE, ETC.:		
Anglo American Corporation (10s.)	1 0 3	19 6
Anglo-Continental (10s.)	3 6	5 0
Anglo-French Exploration	1 0 0	1 1 3
Anglo-Oriental (5s.)	6 3	7 3
ditto, Pref.	8 9	14 6
British South Africa (15s.)	16 6	17 9
Central Mining (£8)	16 7 6	16 17 6
Consolidated Gold Fields	2 8 0	2 12 6
Consolidated Mines Selection (10s.)	12 9	11 6
Fanti Consols (8s.)	8 3	9 3
General Mining and Finance	1 18 9	1 18 9
Gold Fields Rhodesian (10s.)	5 0	5 3
Johannesburg Consolidated	2 3 9	2 4 3
London Tin Corporation (10s.)	9 3	12 3
Minerals Separation	3 5 0	4 2 6
Mining Trust	3 9	4 9
National Mining (8s.)	3	3
Rand Mines (5s.)	5 12 6	6 2 6
Rand Selection (5s.)	17 9	16 3
Rhodesian Anglo American (10s.)	11 6	14 0
Rhodesian Selection Trust (5s.)	5 9	7 6
Rhokana Corp.	5 2 6	6 5 0
Tigon (5s.)	2 3	2 9
Union Corporation (12s. 6d.)	3 18 9	4 8 9
Venture Trust (6s. 8d.)	6 6	6 6

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

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

BUCKET DREDGING

In a paper read before the Dredging Association of Southern Malaya on February 18 last J. S. Whittaker dealt at length with the equipment of the " digging end " of a bucket dredge and treated in turn buckets, tumblers, the ladder, ladder rollers, and hoisting gear. Full extracts from his paper are given here.

BUCKETS.—There are several essential factors to be taken into consideration by dredge operating engineers when getting out specifications for buckets, and they are as follows—

(*a*) The nature of the ground to be dug and the quantity of material it is desired to put through per hour.

(*b*) Ample cutting clearance.

(*c*) Provision of as much bearing surface as possible on the tread.

(*d*) Number of buckets in the band.

(*e*) Type of pin and bush.

(*f*) Bucket lips.

(*g*) The bucket body.

The capacity of a bucket to a great extent limits the length of pin centres when a wide mouthed easy-tipping bucket is required owing to the presence of clay in the ground. It is generally recognized that buckets with long pin centres ride the top tumbler in a more satisfactory manner than those with shorter centres, but to keep the bucket down to the capacity required it is necessary to limit the length of centres or provide more rake on the front of the bucket which, if overdone, would result in reduced carrying capacity owing to spill over the lips when the ladder is well down. A very satisfactory angle for the front of buckets dealing with the average material dug in Malaya appears to be between 40° and 45° from the vertical. The bottom of the bowl of the bucket must of necessity be set up to provide clearance for the back-eye of the one ahead of it and, generally speaking, if ample clearance is provided the angle thus attained is sufficient to guard against excessive spill of material when the ladder is high and prevents premature tipping when turning over the top tumbler.

The curve of the sides of the bucket bowl is dependent to some extent on the height of flange of the lower tumbler, it being essential that the sides of the base of the bucket first come in contact with the flanges of the tumbler when thrust over while digging. The author considers the most efficient shape of bucket is that of a shallow cup, as a bucket of this type will carry up the ladder almost its full capacity when digging free material with the ladder at a very flat angle, and will also tip or discharge clay that is not of a sticky nature. This type of bucket will also carry its full load of free material when the ladder is down below, say an angle of 30°.

Unless buckets are of very large capacity, say exceeding 15 to 16 cu. ft., or of excessive long pin centres a speed of from 23 to 24 buckets per minute can be obtained without undue hammer occurring on the top tumbler, therefore if one bases one's calculations on a bucket speed of say 20 per minute and a 72% to 75% digging efficiency a fairly safe estimate of the size of bucket desired can be arrived at. Should the bedrock be of limestone or other very hard material it would probably be safer to base calculations on about 65% digging efficiency. A bucket speed of from 70 to 80 ft. per minute appears to be satisfactory on modern machines with close-connected buckets and equipped with jigs which will deal with all the material the buckets can dig.

Cutting Clearance.—A reasonable clearance on the sides is an angle of from 12 to 14° to the centre line of the bucket, and on the centre of the lip approximately 35° to a line drawn vertically at right angles to the tread or bottom of the bucket. Apart from the advantages gained in reducing the stresses on the lower tumbler flanges, ladder, etc., a clearance such as suggested provides protection from wear to the rivet heads securing the lip to the bucket body.

Bearing Surface of the Bucket Tread.—The pressure per square inch on the top tumbler wearing plates directly determines the rate of flow of the manganese steel plate and wear to which it is subject, therefore it appears to be incumbent on the designer of the bucket to reduce the pressure to a minimum which, in other words, means as much bearing surface on the tread of the bucket should be provided as is practicable. Usually British manganese steel buckets are designed with an extended or projecting tread on either side of the buckets, serving the double purpose of

slightly increasing the bearing surface, and also by the addition of one or two webs providing support for the bucket body and increasing its rigidity. The necessity for the incorporation of these extended treads into the design appears to the author to be doubtful, and they are in his opinion one of the causes of cracks developing around the body of the buckets. The elimination of the projected tread would alter the shape of the tread from one with parallel sides to that of a wedge shape tread, and this would involve an alteration in the top tumbler design, but only as to the shape of the wearing plate and the position of the lugs or flanges.

Number of Buckets in the Band.—The height of the top tumbler above deck, the digging depth that it is desired to attain, and the length of pin centres are the deciding factors as to the number of buckets required for any particular machine and, as an increase in the number of buckets, or better perhaps the total weight of the band, influences the load on each individual pin and bucket, this factor has to be taken into consideration. The manufacturers of manganese steel buckets contend that the maximum section of metal which can be reliably heat treated is between 2½ in. and 3 in. thick, therefore in order to obtain sufficient strength to carry the load and stand up to the great stresses set up under digging conditions, the front and back eyes of the bucket have to be made of sufficient length. As the total width of the average bucket is very much greater than is required for this purpose, it is a sound principle to calculate the required length of the front eyes allowing an ample factor of safety which then leaves the remaining length, less say ⅜ in. for clearance, for a long back eye giving ample wearing surface for the pin and bush.

The above applies to the most common type of bucket. The size and dimensions of the bucket pin (usually of nickel-chrome or nickel-chrome-molybdenum steel alloy) has to have due consideration on account of the total weight of the band.

Type of Pin and Bush.—There is no doubt considerable difference of opinion among dredge engineers as to what type of pin and bush is the most satisfactory. The best type of pin iand bush in the author's opinion is the L-headed pin with no bushing in the front eyes and a half round or more than half round bush in the back eye fitting against shoulders. It has definitely been demonstrated that if the proper type of L-head pin and fixing device is incorporated in the design of the bucket, no difficulty is found in preventing the pin from rocking in the front eyes; therefore, as there is no movement there, bushing is unnecessary as no wear will take place. There is no difficulty from the manufacturers point of view in forming a recess for the bush that presents two truly ground shoulders and curved surface against which it can be fitted. If the recess is slightly tapered and the bush likewise tapered with an arrow cast on the bucket to indicate the direction of driving, the bush can be driven in a reasonably tight fit and is easy to remove when worn out; there will also be no uncertainty as to which way the bush is to be driven. Owing to the flow of the manganese steel of which the bush is usually made the inclination will be for the bush to become a tighter fit in the recess and the chance of a slack bush causing wear in the bucket eye is very remote, in fact, is practically impossible, if the bush is properly fitted in the first place.

Bucket Lips.—A number of different types of lips have been tried out and all are more or less satisfactory provided sufficient cutting clearance both at the sides and centre is provided, and the rivets that are subject to wear while digging are driven into a countersunk hole thereby ensuring that the heads do not become totally worn off. The usual method of fitting a lip is on the outside of the bucket, a shoulder being cast on the inside of the lip to rest against the face of the bucket and take the shear off the rivets besides protecting the buckets themselves from wear. Patches or lugs at intervals are often cast on to the outside of the bucket body for the former reason. It is not an uncommon experience to find that, though the shoulder is on the lip and/or the lugs on the bucket body, no contact is being made between the lip and the bucket at this point with the result that they do not justify their existence from the point of view of taking the shear off the rivets, therefore at some period sooner or later the rivets become loose. If loose rivets are not detected at once, and cut out and replaced, the rivet hole in the bucket very soon becomes enlarged thereby making it difficult, if not impossible, to secure a satisfactory riveting job subsequently. As it is a rather difficult and expensive job to attempt to bring the inside shoulders of the lip up against the face of the bucket unless fitting strips were provided at intervals over its length, it appears that, unless the bucket is of very unusual shape making it difficult to spring the lips over the lugs, outside lugs cast on the bucket body at intervals is all that is required, the inner shoulder of the lip acting as a protector only. It is useless casting lugs on the bucket body unless the lips bear up against them when the holes of the lip register with those in the bucket, and in order to make sure that the lips will do this all lugs and lips should be ground, or otherwise made, to a template. A.C.I. replica of the part of any particular bucket where the lips fit should be at the service of the supplier or manufacturer of the original lip and buckets, and subsequently at the service of whoever supplies replacements. The author is strongly in favour of a double row of rivets round the lips as it makes a much more satisfactory job than the usual single row, although of course they add slightly to the cost of the lips owing to the extra width of the landing required, but when the lost time, labour, and cost of materials necessary to upkeep the single-riveted type are taken into consideration the double-riveted lip is cheaper in the long run, and the risk of enlarged holes in the bucket owing to slack rivets is considerably reduced. Earlier in the paper it was mentioned that a reasonable cutting clearance at the centre of the lip is that of an angle of about 35° to a line drawn vertically at right angles to the tread or bottom of the bucket, and in order to attain this object we have had the lip splayed out or set up 1½ in. above a line which would normally have been the form of the lip. With a lip of this form, full protection from wear is given to the rivet heads, there is less wear occurring on the back of the body of the bucket owing to less dragging through the dirt being dug and the edge of the lip does not wear at such a sharp angle.

Bucket Body or Bowl.—The general shape of a bucket body makes it self-supporting, so no staying

or stiffening is required, sufficient thickness of metal being the only consideration, but owing to the constant spilling of sandy material from the bucket behind, over the back of the bucket in front of it, considerable wear takes place on that part of the body so it is usual to thicken up the metal over the part affected. Guiding ribs are sometimes cast on or riveted to the backs of bucket bodies to prevent the material spilling over the sides of the leading bucket and missing the drop chute, whether an idler is installed on the dredge or not. They can in any case do no harm. Projecting pieces (wings) are also cast or secured on the fronts of some buckets by some means or other with the object of increasing the capacity of the bucket when digging free material, and also to guide the material more directly into the drop chute. These wings no doubt attain their object, but appear to interfere with the tipping or discharge when in clay.

General.—In order to facilitate handling and prevent damage to wire rope slings there should be no sharp edges on the bucket casting, all corners should be well rounded off particularly the front of the bucket above the front eyes and the edges on the upper side of the back eye. A hole is sometimes left in the bucket body into which an eyebolt or hook can be inserted for lifting buckets, but this is a mistake. An important feature in the design of a bucket is to keep the metal well balanced in relation to wear so that ultimately the bucket has to be discarded for general all round wear and does not have to be thrown out because of the weakness of one or two parts while the remainder are sound, for instance the metal on the under sides of both front and back eyes should be of greater thickness than that of the metal in the upper side where no wear takes place.

The greater number of modern dredges in Malaya are equipped with close-connected manganese steel buckets. Some have a tray or manganese steel link in between each bucket which is more or less just the base of a bucket, and there are still a few in existence with open-connected buckets having four links connecting the buckets together. The close connected buckets, when all is considered, appear to be the most efficient and economical. The disadvantage of the close-connected type of bucket band is the spilling of the material over the back of the leading bucket and consequent wear which takes place combined with loss of material which misses the drop chute and save-all, and the difficulty sometimes experienced in getting hold of a large log.

There are definitely far too many manganese steel buckets discarded owing to cracks developing—principally in the back eyes, but if dredge and operating engineers kept in close touch with the manufacturers the reason and cause of cracks and failures would gradually disappear. Not all failures due to cracks developing can be placed at the door of the manufacturers, in fact, the majority are due to either faulty design of the buckets, or top tumbler, or both.

Top Tumbler.—Four-sided tumblers allowed a large amount of drop and slip to occur creating considerable wear on bucket treads and links, and were discarded in favour of the six-sided tumbler mainly for that reason. There are exceptions, but there are very few top tumblers that are not fitted with manganese-steel wearing plates to protect the main casting from wear and damage due to the buckets riding on them while the dredge is in operation. Owing to the wear on bucket pins and bushes and the consequent lengthening of the turning centres of the buckets combined with the wear occurring on the tumbler plates themselves the buckets do not sit fairly on the tumbler for any length of time and constant attention to the bolts holding down the wearing plates is required in order to guard against movement of the plate and thereby damage to the tumbler casting itself. An ingenious attempt to deal with the lengthening of the bucket turning centres and maintain even contact between the bucket tread and tumbler has been tried out by designing an expanding tumbler consisting of a system of wedges under the wearing plates. The difficulty with this tumbler is that the wearing plates are too narrow and the bolts drawing the wedges cannot be kept tight; the narrow wearing plate owing to its design is expensive and, due to lack of width, wears the bucket tread fairly quickly, while the bolts require constant attention and are the cause of quite a lot of lost time and expense. It is therefore essential to design the tumbler with due consideration to the reduction of the bolts to a minimum number without sacrificing security and to ensure accessibility to the nuts for tightening up purposes, etc. As the turning centres of the buckets increase and the wearing plates are reduced in thickness by flow and wear, M.S. packing plates should be placed under the manganese-steel wearing plates increasing the size of the tumbler to meet the constantly altering conditions and maintaining as near as practicable even contact between the bucket tread and top tumbler wearing plate.

The buckets should sit well forward on the tumbler, or in other words, a projecting horn or heel should be cast on the tumbler in such a manner that it extends well behind the centre line of the pin and gives full support to the back eye of the bucket, even though the buckets do not neatly lap the tumbler.

Flange wearing plates should not come lower than about 1½ in. above the level of the surface of the tread wearing plate and they should be bolted on in preference to riveting in order that when a tread plate is to be removed the flange plate can be easily taken off and no cutting of the tread plate with a blow pipe is necessary. The flange plates can also be packed out as they wear, keeping the buckets central on the tumbler. The width of the tread plate should be slightly less than that of the bucket tread to prevent high spots developing along the sides, and an inch to an inch and a half of clearance each side between the sides of the plate and flanges should be available for side flow of the metal.

The tumbler body is usually of cast steel, which is either pressed on to a very slight taper or shrunk on to a M.S. shaft and keyed at both ends, sometimes a collar is provided on the shaft at one end of the tumbler and a large nut brought up against the other end to prevent end movement; heavy rings are also sometimes shrunk on to the ends of both bosses as added security. There have been instances of top tumblers coming slack on the shafts. The problem was solved by having a tumbler forged complete with shaft as one forging, but this introduced another problem and that was to keep the flanges tight as they were separate from the tumbler and designed to hold down the wearing plates. Loose top tumblers are not of common occurrence and if the shaft is a proper fit in long bosses and due care is taken to secure good fitting keys that

are well driven home, the risk of a tumbler coming slack is very slight.

Long journals of ample area should be provided on the shaft as the bumping or hammering of the buckets on the tumbler is liable to shock the film of oil or other lubricant out from between the journal and bearing surfaces, and this fact should be taken into account when working out the length of bearing to obtain the pressure per square inch on the film of lubricant. Tapered ends to the shaft are preferable to parallel ones, where the crown wheels are fitted. The wheels are much more easily pulled into place and taken off if required, and there is no danger of them becoming slack on the shaft. A taper of about 2¼ in. in the diameter to the foot in length gives very satisfactory results, two feathers are let into the shaft at right angles and the shaft extends beyond the tapered portion in order that a thread fitted with a large nut and washer and hole for a split pin can be provided to keep the wheel hard up in place. Although the nut is driven hard up at the outset it is always possible to get a little on it for the first few months after the dredge has begun operations, but from then on it is very improbable that any more tightening up is necessary or can be done, the wheel having settled firmly on the shaft. With the assistance of powerful jacks and a blow or two with a dolly the wheel can be removed when required without any damage being done to either the wheel or the shaft. On the other hand, a crown wheel with a parallel bore requires considerable labour and time to get it driven on the shaft and keyed up, is liable to work slack unless of perfect fit, and it is almost impossible to estimate the length of time it will take to drive out the keys and remove the wheel from the shaft should it become necessary to do so.

Main Gearing.—There is a difference of opinion as to the merits of the double train of gearing for the top tumbler drive. Personally, the author favours the double drive for several reasons, the driving force is divided more or less equally at each end of the shafts resulting in more even distribution of thrust on the framing, the top tumbler shaft is not subject to twisting force or torsion at the one end like it would be with the single train of gearing and owing to the division of the driving force between two crown wheels the possibility of having wheels working loose on the shaft is very much lessened if not remote.

Main Bearings and Plummer Blocks.—An excellent arrangement of these bearings is to confine them entirely to the central main-framing having elongated C.S. plummer blocks in three sections each side of the well, these sections to meet each other or preferably to have a distance piece in between machined surfaces so that they can be held together by bolts that are a driving fit and formed into a rigid unit ready for bolting down to the bed plate on the framing. The bed plate should have a heavy plate well riveted to the forward end in such a position that there is room to fit a chock between it and the forward end of the bearing unit and it is advisable to fit about 1 in. of hard timber between the machined bottom of the bearing unit and the bed plate as it prevents any inclination for the bearings to rock and permits them to be thoroughly bedded down, a condition difficult to obtain without packing of some sort; the timber also reduces noise due to vibration and appears to last almost indefinitely in that position. The author is inclined to favour white metal, of the correct quality for the job, for all bearings including that of the top tumbler.

Some kind of a seal to prevent grit penetrating into the top tumbler bearing is worthy of consideration, and it would be difficult to improve on the stuffing box and gland with which we have been so successful on lower tumbler bearings. It would, however, be advisable to have a water seal at the outer end of the gland to prevent grit reaching the packing and grooving the shaft. On the latest dredges an outer bearing at the end of the first motion shaft has been installed, near the friction and driving pulley. This is a considerable improvement, having entirely eliminated the whip at the end of the shaft and facilitated fine adjustment of the Seymour friction clutch, and will without doubt reduce the stresses set up by the whip of the shaft on the friction bands and fittings. The Seymour friction is lined with brass wire woven Ferodo, the ordinary Ferodo lining being found unsuitable for the purpose.

Lower Tumblers.—For various reasons the author considers that the choice of design to obtain greatest efficiency and economy lies between tumblers consisting of two manganese-steel half tumblers shrunk on the shaft and the one piece manganese steel casting pressed and keyed on the shaft. All manganese-steel tumblers must be provided with slots or grooves on the treads to allow for the flow of the metal which occurs under impact and pressure of the load they have to carry and if these are incorporated in the design dishing of the flanges is not likely to happen.

As to the lower tumbler shaft, if the tumbler is in two pieces—that is, consisting of two cheeks or half tumblers—square shoulders for these cheeks to come up against should be avoided as they encourage fracture of the shaft by concentrating the bending stresses at these points. Where the shaft is reduced in diameter for the journal or wearing sleeve, fillets of large radius should be in evidence. Sleeves of chrome steel shrunk on to the shaft and with flange provided with jaws to fit into recesses in the tumbler boss are much superior to using the shaft itself as a journal, for the sleeves are easily renewed if necessary and never work loose, so require no attention whatever. The most satisfactory bearing is for lower tumblers to be fitted with a gland and stuffing box on the inner end and a cap fitted with a heavy adjusting screw at its centre which presses against thrust washers, on the outer end. To seal successfully a bearing against grit entering end movement must not occur on the shaft for, if it does, grit will eventually find its way into the bearing with disastrous results; it is also essential in my opinion to retain the pressure of the grease or lubricant above that of the water outside the bearing when the tumbler is at its greatest depth. An adjustable thrust as explained will prevent the end movement of the shaft provided the jaws of the ladder are not springy and a good stuffing box and gland properly packed in conjunction with a non-return valve through which the lubricant may be forced with a grease gun will retain the pressure in the bearing for at least 30 hours with a grease of the same specification as the Vacuum Oil Co.'s B. 4.

Ladder.—There are several types of ladders the two most generally in use being that with a tray a foot or so below the rider plate, or top of the ladder and diagonal bracing below, and that with the

sloping bulkheads or diaphragms with a clear open space in between them for the depth of the ladder. From the point of view of rigidity there does not seem to be a great deal of difference between the two types.

Deep-digging dredges, which are equipped with caterpillar tracks fitted into the under side of the ladder, are machines that would of necessity require trays over at least that portion of their length occupied by this track in order to prevent excessive wear and possible fouling due to sand, lumps of clay, and roots, etc., falling on top of it. Normally the top end of a ladder swings on a pivot shaft situated several feet below and forward on the top tumbler centre so that the buckets are only running in a true line over the ladder rollers and top tumbler when the ladder is lowered to approximately 50% of its maximum digging depth. When it is high there is very little, if any, load on the first three or four rollers at the top end, and when it is at maximum depth these rollers are carrying an excessive load. There are instances of ladders swinging on trunions which are part of the top tumbler bearing and have their centres located at the same point as the top tumbler. This method obviously eliminates the varying load on the top end rollers but may be inclined to throw the bearings out of line on a powerful dredge. The author considers that there would be no great difficulty in providing the pivot shaft with an eccentric motion in such a manner that whatever angle the ladder was at the top rollers would receive only their due share of the load and not be either under- or overloaded as they are at present.

To be successful in retaining grit-proof lower tumbler bearings it is essential that the jaws at the lower end of the ladder must be very rigid. Considerable success in attaining this object has resulted by making the jaws of C.S. of heavy section in two pieces firmly bolted together and riveted into the plate work of the ladder. The castings are so designed that they extend upwards to a level equal to that of the outer diameter of the lower tumbler flanges; a horn of C.S. increasing the height a foot or more is bolted or riveted to the outer side of these castings in such a manner that when the buckets come off the tumbler they sit on the main casting and are prevented from swinging over the end of the ladder by the horn. This has proved of inestimable value as the buckets cannot get into such a position that it is impossible to run them back on the tumbler.

The under side or bottom of the lower end of a ladder should be well protected by fore and aft skids of M.S. or harder material to prevent the unevenness of the bedrock forcing the slack of the buckets up against the bulkheads or diagonal bracing and tearing it out or otherwise causing damage to the structure; it is not an unusual thing to see a mass of twisted and torn plate work under a ladder owing to lack of this protection. The author prefers the longitudinal chafer beams; they help slightly in stiffening up the ladder and if well designed do not appear to give any trouble: the radial type do not have this advantage and wear grooves in the pontoon chafers, though they are less likely to become foul of timber when lifting the ladder.

Ladder Rollers.—Here we have, considering its simplicity, the least satisfactory part of the machinery at the digging end of a dredge, bent shafts and worn out bearings and journals are a common occurrence, and there is considerable room for improvement in the design of ladder rollers. So far the most successful rollers in the author's experience were chrome alloy and manganese steel one-piece castings pressed on to the shafts without any keys and having a tread 3½ in. thick, and the ends of the shafts being sleeved with ⅜ in. thick chrome alloy journal; there being no fillets but a long taper, where the reduction in diameter of the shaft occurs to accommodate the sleeve. The journal was running in a close grained C.I. bearing let into a C.S. bearing shell and the usual stuffing box and gland with two turns of greasy hemp packing providing the seal.

In order to prevent end movement in the bearings and bring them directly under the load and with the idea at the same time of reducing the pressure per square inch on the lubricant the author had several rollers made of chrome alloy steel which run loose on a fixed shaft, the roller itself was made in two pieces bolted together at the centre and stuffing boxes and glands were arranged for at each end of the roller. The shaft is parallel, but midway along it has a collar shrunk on to act as a thrust, washers are provided to run against the collar and a recess in the castings, the two half rollers being put on from each end of the shaft and when bolted together no end movement occurs and owing to the length of the roller a bearing surface of nearly 100% greater length than permissable with the other type was possible. A grease reservoir or recess is left in the castings into which grease is forced by a grease gun through a non-return valve, and a grease pressure is therefore obtainable. The author is not in favour of numbers of wearing plates, etc., which are liable to come loose for the reason that far too much time and labour are spent on tightening up bolts or replacing loose rivets. It is much more economical in his opinion to have a roller of simple design which can be discarded when worn out and replaced by a complete new one.

Ladder Hoisting Gear.—Included in this equipment are the top and bottom set of sheave blocks, the wire rope and the hangers; the first of these if resting on the top side of the bow gantry in the form of a fixed pin set in chairs, is in a very accessible position and should require no attention whatever for years except to ensure that the sheaves are being properly lubricated. As the sheaves of a block all revolve at different speeds, the wear on the pin and bushes naturally varies; therefore a means of separately lubricating each sheave is absolutely necessary. A very simple and effective method of doing this is to provide a separate hole along the pin and lubricator, for each sheave. If one hole only is provided the lubricant will take the line of least resistance, and some of the sheaves will be starved of their share which will soon lead to trouble. These remarks also apply to the bottom block, but the sheaves here require to be made grit-proof as they spend most of their life working under water in slimes; very satisfactory results can be obtained by stepping the ends of the sheave bosses where they come together and inserting a turn of greasy hemp packing into the groove thus provided, the packing being held secure by a clamp bolted around it.

All wire-rope sheaves should be of C.S. with machined grooves, well splayed out to ensure smooth entry of the rope as the sheave revolves, and the bushings for the lower blocks preferably of close-

grained C.I. Gun-metal or phosphor bronze bushings are quite satisfactory for the top block sheaves, though C.I. will run well here and is cheaper. Pins of nickel-chrome steel give excellent service and are worth the extra money they cost.

The very best quality wire ropes should be used in a position of such importance as that of a ladder hoist, and will well repay good care and attention as to lubrication and even winding on the winch drum.

Double sets of hangers and blocks are preferable to the single set on all but very small dredges, as the single block with a large number of sheaves badly twists the ladder when lifting and lowering.

The use of two separate lines, one for each set of blocks or the single long line with compensating sheaves, seems to the author to be a question as to which is the most suitable for the particular job. If the winch drum is large and the line runs well on to it he can see no objection to the two single lines for they certainly have the advantage of preventing the ladder canting badly when the buckets are off the tumbler, and in the event of the carrying away of one line the other will probably prevent the dropping of the ladder. The single long line with compensating sheaves without doubt adjusts the load so that it is evenly distributed on both blocks, but allows of considerable canting of the ladder when the buckets are off the lower tumbler, and should there be a double set of longitudinal chafers on the ladder difficulty may be experienced in raising it through the well under these conditions. A sort of compromise between the two methods can be arrived at where a single line is installed by fixing a stopper on the line between two compensating sheaves in such a manner that the movement is limited to, say, from nine to twelve inches either side of the centre ; the stopper coming into contact with a bracket of substantial construction riveted to the gantry framing on either side before it reaches the sheaves. This arrangement will deal with any normal variation in the load between the blocks that is likely to occur and may possibly prevent the dropping of the ladder in the event of the line on one set of blocks breaking.

Wherever wire ropes are used the sheaves should be of large diameter if good and reliable service is expected from the ropes ; a minimum diameter for the bottom of the groove being about twenty-four diameters of the rope for dredge work. The bottom block sheaves require to be covered by a cowl or hood to prevent debris from entering the grooves of the sheaves and becoming compressed, and which would if not removed eventually fill the groove up and dislodge the line. The grooves should be deep and a minimum clearance allowed between the sides of the sheave at its periphery and the framing of the blocks so that the line cannot possibly jam itself should a careless winchman allow it to slack off sufficiently to come off the sheave. From the top set of blocks the lines should preferably pass over an inclined sheave on top of the gantry directly down to the winch drum and not brought under a sheave bolted to the deck, if it can possibly be avoided, the more bends there are in them the shorter will be their life, furthermore there is more scope for lengthening the distance between the drum and the first lead by adopting the former method. If this distance or dimension is short the lines wear considerably owing to sliding down the adjacent turns as they wind on to the drum due to the angle at which they approach it as they move from the centre towards each end, besides which difficulty may be experienced in getting the turns to run evenly on the drum. If the turns do not run evenly on the drum a portion of the line will force itself down between two of them and crush another part of the line.

When starting up a new dredge in shallow water and a narrow paddock which is generally the state of affairs unless a good paddock has been especially left by another machine, it is a good practice to run only sufficient line on to all winch drums as is needful, then more line can be run on as conditions permit, in this way damage by crushing of the line will be avoided, and the manufacturers of wire ropes will not get so many complaints about supplying faulty ropes.

A few remarks by Mr. G. D. Kidd on locking devices for bucket pins are given at the end of the paper. Mr. Kidd says that there are three methods of locking the L head bucket pin :—

(1) By means of a wedge key.
(2) By means of a set screw.
(3) With the " Kent " key.

The wedge key is usually about 5 in. long, 1 in. wide, and $\frac{3}{8}$ in. thick with about $\frac{1}{16}$ in. taper in its length. This type of key is driven in between the top of the pin head and the place provided on the bucket. A bucket band fitted with the wedge key requires constant attention, it becomes a routine job driving up slack keys and replacing ones that have fallen out. In time and due to keys falling out, the edge of the pin head and projection on the bucket become damaged with the result that it is impossible to keep a key in place. Consequently the pin works in the front eyes of the bucket causing unnecessary wear both on the pin and the bucket.

Next comes the set screw which is really a tap bolt usually made with about $\frac{3}{4}$ in. gas thread. It is screwed into the pin head and locked in position by unscrewing until the bolt head is tight against the projection on the bucket. Some people fit the bucket pin with the set screw on the upper side of the pin head and others on the under side. Either way of fitting gives the same ultimate result. In time the screw thread becomes distorted and any endeavour to move the screw either way usually results in shearing. A bucket band fitted with this type of locking device will lead a similar life to one fitted with wedge keys, so as far as the efficiency of the two is concerned there is little to choose between them.

Finally, the " Kent " key fitted to a properly designed bucket and pin. This is a taper key and screw combined, and is driven in on the underside of the pin head away from the front eye, the screwed end entering a lug cast on the bucket which serves as a landing for the nut thereby locking the key. The advantage of this key can readily be seen. It is easily driven up into position and finally locked. This type of key definitely prevents any movement of the pin in the bucket eyes, and definitely prevents the bucket pin from working out. Due to the design of the " Kent " key and method of fitting it has been proved that there is a tendency for the key to tighten up rather than work slack. Very little attention is required to a bucket band fitted with " Kent " keys. In fact after the pins have settled down and the keys finally driven up, no further attention to the band is required until it becomes necessary to rebush.

VENTILATION

A paper by D. Harrington, of the United States Bureau of Mines, set down for discussion at the annual general meeting of the Canadian Institute of Mining and Metallurgy, is reproduced in the *Canadian Mining and Metallurgical Bulletin* for March. The author, after discussing the importance of ventilation for metal mines, sets out some general conclusions that he makes after many years of observation. These are reproduced here—

(1) In mining it appears that ventilation, fire protection and prevention, health, safety, and efficiency are very closely interlocked.

(2) There is at least equal reason for providing adequate ventilation for most metal mines as for providing ventilation for coal mines.

(3) Metal mines rarely, if ever, make provision for ventilation until forced to do so by some untoward condition or occurrence; coal mines on the other hand, almost universally provide for ventilation.

(4) Efficient ventilation of metal mines consists in supplying at all times such volume of circulating air at places where men work as will enable the worker to exert himself in comfort at maximum physical capacity without endangering his health.

(5) Many, probably most, operating officials of metal mines are ignorant of the principles of air circulation; this is true of those technically educated as well as of those without technical training.

(6) Workers in metal mines, including shift and other bosses, should be educated to respect ventilating devices, such as doors, regulators, overcasts, brattices, fans, etc., as coal miners do and to become as familiar with those devices as coal miners are. Many present-day reactionary metal miners and bosses consider ventilation a useless fad and obstruct rather than aid ventilation improvements.

(7) Ventilation should be under definite, constant supervision and preferably the person in charge should report to the highest officials, as many local officials in metal mines are not in sympathy with ventilation betterments.

(8) Each mine should be ventilated wholly within itself; inter-ventilation of mines is likely to be dangerous, inefficient, and unsatisfactory.

(9) Every mine, coal or metal, should have a mechanically-driven fan or fans placed preferably on the surface, fireproof housed, and capable of reversing air currents with minimum delay. Metal mines should provide fan ventilation from start of opening in order to avoid dangers from explosive fumes, dusts, heat, etc., and provide fresh air to workers.

(10) At seasons of the year when the temperature of surface air and of underground rock and water are about equal mines relying on natural ventilation are likely to have periods when air circulation is sluggish or ceases utterly or reverses in direction.

(11) At time of mine fire naturally ventilated mines are likely to be at a decided disadvantage through inability to control the direction of air currents.

(12) There are records of naturally or otherwise inadequately ventilated mines filling with carbon dioxide or other gas overcoming some of the workers (in some cases with fatal consequences) and compelling suspension of work for considerable periods of time. Upon establishment of efficient mechanical ventilation this situation is readily controlled.

(13) Workers in many metal mines are much less healthy than workers in coal mines, due largely to the superior ventilation of the collieries.

(14) Miners' consumption, the scourge of metal miners, is caused primarily by breathing very fine particles of certain mineral dusts and especially of siliceous dust. Over 50% of mineral-producing mines are working in more or less siliceous material and, through lack of ventilation, are giving this dangerous dust maximum opportunity to exercise its harmfulness. Lead poisoning afflicts workers by skin absorption of soluble dust of lead ores as well as by breathing of such dusts.

(15) The best remedy for the dust menace in mines, other than preventing its formation, is the universal coursing of currents of air to remove the dust, as it has been proved that the very fine, most dangerous, dust in metal mines remains suspended in still air several hours.

(16) Metal-mine dust, acting through miners' consumption, lead poisoning, bronchitis, etc., is the chief instrumentality in causing perhaps more deaths annually among the approximately 200,000 metal miners in North America than coal dust causes to the approximately 700,000 coal miners through explosions.

(17) It is fairly well established that miners' consumption is caused chiefly by siliceous dust, but it is probable that any kind of dust in large quantities in finely divided form in mine air will prove harmful to workers ultimately. Investigations in metal mines of the United States indicate that the air of mines so far studied is from 7 to over 40 times as dusty as in South African gold mines.

(18) Intake air of metal mines is frequently rendered dusty by having a crusher house or other dust producer near the collar of the intake air shaft, or by having ore skips or cars or ore-dumping places in intake air passages without the slightest attempt to allay the dust produced or to prevent its entering the mine.

(19) The dustiest, most unhealthful, occupation underground is dry drilling and the average dust content of air in places where this work is done in five large mines in various parts of the United States was 205 milligrams per cubic metre of air; yet for similar work in South African mines, but using available precautions against dust formation, the dust content of air is said to be less than 5 milligrams per cubic metre of air.

(20) While there are regulations in many of the States of the United State to prevent dust formation in drilling these regulations are not always lived up to. Miners, while recognizing the danger from dust, often prefer to take the risk rather than endure the slight discomfort or extra trouble of using the precautionary methods or devices; and mine and State officials appear to feel that, unless the miner will willingly aid in protecting himself, they can not force him to protect his own health and incidentally that of his family. Dust prevention devices of proved success, such as present-day self-rotating wet stopers, should entirely supplant dry drills and their use should be enforced upon both miners and operators in metal mines, as there is absolutely no valid excuse for dry drilling in present-day metal mining except in a very few instances. To

date, no workable device is available for removing dust in dry drilling in underground mines.

(21) Spraying devices available to reduce dust while drilling may be effective if used intelligently; on the other hand, they may even intensify the air dustiness if used without intelligence and, unfortunately, the latter is generally the case. Efficient water drills are now available for all purposes in metal mining (including efficient wet stopers for upper holes) and dry drilling should be prohibited.

(22) Some metal mines with high dust production under certain conditions at working faces have comparatively low dust content of the air in these places at other times and have low average dust content of all places due to efficiency of ventilating currents, especially at working places. Significantly, these mines appear to be singularly free of miners' consumption or other diseases, yet the employees work at top speed and the material handled is highly siliceous.

(23) The use of poorly-placed compressed-air hose blowers at working faces frequently intensifies air dustiness by allowing high-velocity compressed air streams to pass through dry, loose, finely-divided ore or other material being drilled, shovelled, or otherwise handled, and thus forcing workers to breathe this air highly impregnated with dangerous fine dust.

(24) While finely-divided dust in mines is probably the chief cause of miners' consumption, it is now recognized that there may be other factors of almost equal influence, such as high temperatures and humidities, harmful gases, and lack of air movement; all of these defects are readily remedied by ventilation.

(25) It appears that with dry-bulb temperature below 75° Fahr. mine working places may be comparatively comfortable, irrespective of air movement or relative humidity. However, the presence of air heavily depleted of oxygen (say below 18%) or impregnated with gases such as carbon dioxide, carbon monoxide, oxides of nitrogen, etc., any or all of which may be produced in blasting, may produce uncomfortable or unsafe conditions; also places may be both uncomfortable and unhealthful if large quantities of finely-divided dust are present.

(26) With dry-bulb air temperatures above 75° Fahr. comfort and maximum working efficiency can be attained only when the air is moving, this being especially true if the air has high relative humidity. The exact velocity necessary is a variable, dependent upon the temperature and humidity.

(27) Saturated atmospheres, up to nearly blood temperature, may be made endurable and even to a considerable extent comfortable, by providing sufficient velocity.

(28) In still air in metal mines with about 85° Fahr. and 90 to 100% relative humidity there is likely to be little effect on persons completely at rest, but, upon doing even moderate work, body temperature is likely to rise to over 100° Fahr., blood pressure to fall perceptibly, and pulse beat to rise materially. In still air with temperatures 90 to 100° Fahr. and above 90% relative humidity, even when the body is practically at rest, body temperature rises quickly, reaching over 102°; blood pressure is likely to fall rapidly; pulse beat will increase abnormally and be very sensitive to even slight exercise; perspiration is very profuse; and dizziness, physical weakness, mental sluggishness, and headache are experienced. Upon attempting even light work, these symptoms are likely to be greatly augmented.

(29) Relative humidity, even up to the saturation point, does not appear to be harmful to health, comfort, or efficiency until temperatures run above 75° Fahr.; and if sufficient air movement is supplied high relative humidity is not particularly harmful until temperatures are well over 90° Fahr.

(30) With exception of blind-end working faces metal-mine air in general is not particularly deficient in quality. However, blind-end faces of drives, cross-cuts, rises, winzes, and stopes in metal mines are likely to have air deficient in oxygen and high in nitrogen or carbon dioxide, and possibly in carbon monoxide, oxides of nitrogen, or other impurities. There are many cases on record of asphyxiation in metal mines from these gases.

(31) Practically all of the explosives used in metal mines give off small percentages of poisonous fumes—carbon dioxide, hydrogen sulphide, or oxides of nitrogen—when fired and sulphur dioxide or trioxide may be found when blasting ores high in sulphur content. If these fumes are not removed from confined places by ventilation, they cause headache, nausea, and even death. The gelatin dynamites give off less quantity of dangerous gases than do the ammonium dynamites and these give off much less than the straight nitroglycerin dynamites; hence, the latter should not be used underground and all places using any kind of explosives should be thoroughly ventilated after blasting and before workers arrive. No blasting of any kind should be allowed during the working shift. Good ventilating currents should also be provided while shovelling blasted ore at the face, to prevent workers from being affected by headache, nausea, or other illness resulting from breathing explosive fumes stirred out of muck piles. Compressed-air blowers are ordinarily not particularly effective in removing explosives fumes.

(32) In stagnant air comparatively small quantities of impurities—such as 0·30% or over of carbon dioxide, 0·02% or over of carbon monoxide—or oxygen below 20%, give headache, dullness, etc., and this is particularly true when temperatures are above 80° Fahr. However, these small quantities of impurities are not likely to be very noticeable when there is perceptible movement of the air.

(33) Frequently, blind-end working faces in metal mines have air so depleted of oxygen that a candle will not burn and carbide lamps must be used; hence, oxygen is below 18% and carbon dioxide may run several per cent. Occasionally, entire mines are found with this condition, which many metal-mine managers hold to be perfectly all right. There is absolutely no question that men working in an atmosphere which will not support combustion of a candle cannot deliver maximum efficiency and that their health must suffer ultimately.

(34) Mines with cool working places which allow men to work at top speed, especially when contracting, are likely to be extremely dangerous to health of workers unless provision is made to remove explosives fumes and other gases and fine dust from working places by ventilating currents.

(35) Mines with high temperatures, above 75° Fahr., and high humidity, above 85%, are likely to lose from 25% to as much as 75% of the efficiency of workers and workers are likely to

become unhealthy ultimately unless moving currents of air are supplied to working places. Unhealthfulness and inefficient results are hastened and intensified if fine dust is present, especially siliceous dust, and if blasting is done, especially when men are in the mine.

(36) Many accidents in metal mines are due to deficient ventilation. Failure to remove smoke and fumes from explosives prevents proper inspection of working places to make them safe; and, in addition, many men have been asphyxiated in explosives fumes; in hot, humid, stagnant air men are likely to be affected by dizziness or by lack of ability to think clearly or quickly, or they may faint at an inopportune time and be killed; also there are numerous instances where men have been known to drop dead due to heart failure in these hot places.

(37) When air temperature is over 75° Fahr. the ensurance of air movement or velocity at working places is of more importance than any other consideration in giving adequate metal-mine ventilation, provided the air is reasonably free of noxious gases.

(38) While variations in surface-air temperature and humidity may have a noticeable effect in mines with shallow workings, in general they change conditions very little, if at all, at faces in mines with extensive workings; hence, underground working temperatures in large mines vary but little due to outside air conditions.

(39) Air flowing in underground passages rapidly takes the temperature of the surrounding rock. The rate of change is variable and frequently is as high as, or higher than, 1° Fahr. for every 100 ft. of travel, even when air velocity is several hundred feet per minute. Still air underground rarely varies more than a few degrees from the temperature of the surrounding rock or water.

(40) Rock temperature generally increases with depth, the rate of increase varying from 1° Fahr. or more per 100 ft. of depth in certain districts of the western part of the United States to but one-half or one-third of a degree Fahr. per 100 ft. of depth in other regions, both of the United States and of foreign countries. In Montana rock temperature in copper-sulphide veins is about 108° Fahr. at a point 3,800 ft. below the surface, rate of increase being about one degree per 100 ft. of depth. In a lead-sulphide vein in the Cœur d'Alenes in Idaho rock temperature 2,000 ft. below the surface was but 50° Fahr. In a Michigan copper mine with native copper ore rock temperature was about 82° Fahr. at a point 5,000 ft. below the surface. In a gold-bearing quartz vein in Arizona rock temperature was 90° Fahr. at a point 600 ft. below the surface, while in a quartz deposit carrying copper sulphide in another Arizona district rock temperature 600 ft. below the surface was but 70°. Temperature of coal in place in coal mines in the United States is rarely above 70° Fahr. and is generally much lower. Magazine articles give the rock temperature of the Kolar goldfield in India at 118° Fahr. at a point 6,100 ft. below surface, and give 98° Fahr. at the 4,000-ft. level of the St. John Del Rey mine in Brazil, while it is calculated that at the 8,000-ft. level of City Deep mine in South Africa the rock temperature will be but about 97° Fahr.

(41) Rock temperature may vary at the same depth in different kinds of material. A copper-sulphide ore with quartz gangue in a mine in the western part of the United States had rock temperature several degrees higher than a zinc-sulphide ore in quartz gangue in a parallel vein about 200 ft. distant, both on the same level and both practically free of water.

(42) Water standing still or flowing on the floor in mines readily communicates its temperature to surrounding air; water dripping through the air quickly brings the air practically to the temperature of the water drippers and profuse water drippers will determine the temperature of the air almost irrespective of rock temperature. Water temperature underground is generally the same as that of surrounding rock, but not always.

(43) Mines having rock temperatures, hence generally air temperatures, above 80° Fahr. frequently have available water piped from the surface which is found underground with temperature below 70° Fahr. Few if any mines take advantage of this water to cool the air by installation of sprays, yet this is a very effective method of reducing the temperature of the air. Mine managers state that they fear that water sprays will cause excessive humidity, forgetting that mines generally have the humidity anyway and that, if the air can be cooled to 75° or below and given a slight movement, the high humidity is not harmful. Physiological experimental work in South African mines shows that men working in stagnant air with a relative humidity of 95% and a temperature of 87° Fahr. increased the amount of work performed 46% by the mere expedient of installing a small fan to move or stir the air, showing that high humidity in itself is not particularly detrimental, at least until temperatures are well above 90° Fahr.

(44) Air passing through fans frequently has the dry-bulb temperature increased several degrees Fahr. and the relative humidity automatically decreased. In one instance an underground fan with air delivery of over 20,000 cu. ft. per minute had 8° higher temperature of air at delivery than at intake, the points of measurements being less than 50 ft. apart. Similarly, small fan-canvas pipe units used underground for local ventilation frequently have delivered air several degrees higher in temperature than that of intake air at the fan.

(45) Small electrically-driven fans with galvanized iron or canvas or other flexible tubing are being widely used in metal mines to carry air to dead ends. The galvanized iron has the advantage of allowing of reversing of air currents to pull smoke out after blasting, then to force moving air to workers after removal of the smoke; moreover, it does not decay as fast as canvas. The flexible tubing must be, in general, used only in forcing air to the face, its advantages being low first cost, ready installation and removal, flexibility in conforming to bends or turns, and ease of repair. Moreover, because of its ready installation and removal, the flexible tubing can be brought close to the working face at ordinary times and easily removed prior to blasting, to prevent its destruction. Either method readily admits of placing from 500 to 5,000 cu. ft. of moving air per minute at the working face at comparatively small cost.

(46) Compressed air from the end of air hose is used to a very great extent to remove explosive fumes from faces or to ventilate hot, stagnant, blind-end workings in metal mines. These blowers deliver about 100 cu. ft. of air per minute, but its temperature rarely varies much over two or three degrees from the temperature of the rock

and air of the working place. Such compressed-air blowers are inefficient as to removal of smoke or gases, provide comparatively little pure air, and give very little reduction in the temperature of the surrounding air. Moreover, it costs about 100 times as much to place 1,000 cu. ft. of compressed air at a working place as to circulate a like amount of air by ordinary ventilation methods.

(47) The use of electrical machinery underground causes considerable increase of air temperature locally. A magazine article a few years ago described a proposed fan installation at a South African mine to force 75,000 cu. ft. of air per minute from the surface into a mine for the sole purpose of ventilating the region around an electrically-driven underground hoist, this air to be removed from the mine after passing through the hoist room.

(48) Cooling of air in mines is effected by use of ice or sprays of cool water, by refrigeration, by rapid coursing of air brought from the surface or carried through workings with cool walls, and by excluding air from abandoned workings and return air from currents of active workings. Water sprays are not employed nearly as much as they should be; ice is used to a slight extent in the United States but is probably employed much more extensively in South Africa; refrigeration is costly and found only in a very few mines; and the rapid coursing of air currents from the surface, which can be brought about most efficiently by the establishment of definite separate splitting systems, is used only occasionally, though it is quick, cheap, and efficient. Failure to seal abandoned places having decayed timber and hot rock or water sends much unnecessary heat into metal-mine air, and re-using of return air has the same effect.

(49) At time of fire in a metal mine lack of an efficient ventilation system may be disastrous. Each mine should have fans which should be so placed as to be inaccessible to fire, have fire-proof housing, be capable of quickly reversing air currents if desired, and preferably installed on the surface. There should be a definite system of air splits such that fire in one place may not necessarily fill the entire mine with poisonous fumes. This provision is of vital importance, yet the writer knows of but two important metal mines which have made even a reasonable attempt to establish this excellent safety feature, the United Verde mine at Jerome, Arizona, and the Frood mine at Sudbury, Ontario. There should also be a system of doors near shafts, in the levels leading from them, such that the entire shaft may be readily isolated in case of fire, or any part of the mine may be isolated from the shaft.

(50) Experimental work in mines reveals that after smooth-lining of shafts which previously had ordinary exposed timbers, there will generally be a reduction of friction to such an extent that 50 or more per cent additional air can be handled by the same power. If the smooth lining is done with gunite it also serves as a fire retardant. Preferably, at least the intake-air shaft should be fire-proof and, if possible, all shafts or heavily inclined openings which carry air, or through which men travel or are transported, should be fire-proofed.

(51) While the cost of establishing a ventilation system for a large mine is variable, the cost of operation is not particularly burdensome. The operating cost will almost invariably be offset by savings, in compressed air and in increased efficiency and health of employees, which frequently will cover the entire cost of the investment within a few years. If a fire occurs, an efficiently installed and operated mechanical ventilation system is of incalculable value and the absence of such a safeguard is likely to result in a heavy loss of property and possibly of life.

THE DRAGLINE IN ALLUVIAL MINING

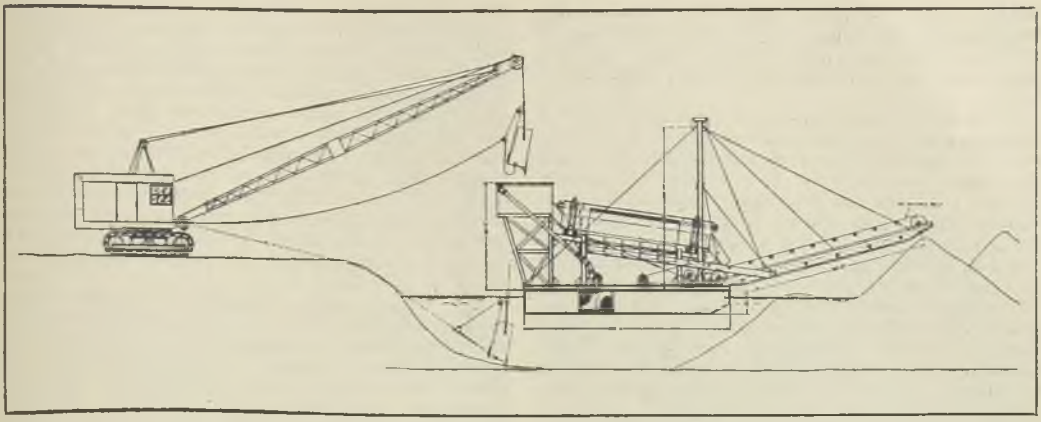
Reference to the use of the dragline excavator in alluvial mining has frequently been made in past numbers of the MAGAZINE and readers will recall articles on this subject by S. A. Westrop in January, 1931, and by W. E. Sinclair in January, 1932. Similar work is described by W. F. Boericke in *Mining and Metallurgy* for April, where he deals with the development of limited dredging areas with a dragline excavator and what is called a stacker scow. The author says that to fill the gap between hand mining of placer ground with its high operating costs on the one hand and large-scale dredging on the other, where a large proved acreage of ground is necessary to amortize the heavy capital expense, the New York Engineering Co. has recently designed a stacker scow to handle any deposit suitable for dredging purposes, but which may not be extensive enough to warrant a large capital investment.

The stacker scow is shown in section in the accompanying figure together with the dragline excavator. It is virtually the stern half of a 3-cu. ft. dredge, incorporating the dumper hopper, revolving screen, gold-saving tables and sluices, tailing stacker, and wash-water pumps. In combination with a modern dragline excavator it is claimed that this equipment is flexible and will dig, wash, and stack material economically. It is portable in the sense that it can be readily moved from spot to spot if desired. The position of the scow is fixed by four manila ropes fastened to trees on the shore and made fast to cleats at the four corners of the hull. No winches are necessary for manipulating the scow since one man can move the floating machine. The scow will screen, wash, and stack the tailing of 50 cu. yd. of gravel per hour, or approximately 1,000 cu. yd. per day. Three pontoons, bolted in the field, comprise the hull. Each pontoon is a separate watertight unit of all-steel welded construction, 30 ft. long, 8 ft. wide, and 3½ ft. high. Structural beams form the superstructure, with the bottom chord bolted to the pontoons.

The hopper is approximately 8 ft. square. The screen is of the standard revolving dredge type 4 ft. in diameter by 24 ft. long over all. The stacker will be 30 ft. long and built for a dredge stacker belt 27 in. wide. By suspending the stacker by guy cables from the rear gantry the height of discharge can be varied within its limitations.

Ten gold-saving tables will be provided, equipped with standard dredge riffles. The tables will discharge into the side sluices which will also be provided with riffles to within the stern of the scow.

Power for screen and stacker drive will be furnished by a 40-h.p. motor belted to a countershaft with two friction clutches for driving each



Drag-Line Excavator and Stacker Scow.

individually. Another 40-h.p. motor will drive two pumps, a 6-in. high-pressure pump with a capacity of 1,000 g.p.m. against a 50-ft. head, and a 6-in. low-pressure with a capacity of 1,200 g.p.m. against a 30-ft. head.

This machine is the logical development of the plan that the late C. W. Purington and J. P. Hutchins worked out some 22 years ago for a placer deposit on the properties of the Orsk goldfields in eastern Siberia by means of a dragline excavator and a fixed sluice. The dragline excavator was a 1-cu. yd. machine with 80-ft. boom and was one of the earliest of its type. It was mounted on a turntable which rode either on railroad wheels, for a track had to be provided, or could be mounted on round wooden logs and skid timbers serving as a track. For the sluice water a 10-in. centrifugal steam-driven pump was used.

After one season's operation it was found that this method was not economical since the frequent necessary shifting of the sluice to provide room for the tailing, the problem of sump for the centrifugal pump, and general inflexibility of the equipment combination militated against profitable operation. Messrs. Purington and Hutchins consulted the New York Engineering Co. and it was decided that the water question and flexibility as well as tailing disposal could be greatly improved by mounting the sluice on a scow and then operating the equipment similar to a dredge, except that the digging would be performed by the dragline excavator.

After preliminary plans were drawn up to follow out this suggestion the question arose about treating stiff clay mixed with gravel containing considerable gold. With this problem in mind, a stacker scow was designed having a roughing screen, which rejected material above 6 in. while undersize was fed into a log washer about 5 ft. wide and 25 ft. long, where the clay was beaten into a liquid pulp and the gold liberated so it could be saved on standard gold-saving tables. After the material passed through the clay or log washer it discharged into a standard dredging screen having ½-in. and ⅜-in. perforations and from there it was treated the same as on a dredge. The tailing was disposed of over a standard tailing stacker. This machine was then built as a steam-driven machine, utilizing boilers, engines, and pumps available on the property.

Considering the circumstances under which the equipment worked the results were satisfactory. The inclusion of a clay washer, which necessitated the use of a roughing screen, put all the boulders above 6 in. through side sluices into the pond which, of course, made up piles of boulders near the forward end of the scow and slowed up the operation since the dragline excavator had to rehandle some of this material, which was deposited on the virgin ground.

This equipment handled about 20,000 cu. yd. per month at an average operating cost of 17c. per cu. yd. After electricity was available, and since the size of the deposit warranted it, the stacker scow was extended and made into an electrically-driven dredge by the addition of a 3½-cu. ft. bucket line.

THE CRACOW GOLDFIELD, QUEENSLAND

An abstract of a report by Dr. Loftus Hills on the Cracow goldfield, Queensland, is given in the *Chemical Engineering and Mining Review* of Melbourne for March 6. The author says that the economically important gold-bearing deposits of Cracow are located on a line of major faulting and a transverse shear zone. Such a conclusion has an important bearing on the status of the field, in that it must serve to differentiate between those occurrences which are situated within these major controlling structures and those that are not.

The country rocks of the Cracow goldfield are andesites and rhyolites, both of which represent old lava flows, the latter overlying the former, and the series dipping westwards at a moderate angle. The rhyolites include flows and tuffs and are not more than 200 ft. thick. The andesite shows vesicular facies in places. Its correct scientific name is a porphyrite with typical orthophyric structure. In field purposes the term andesite can be retained although the rock is a porphyrite and not a typical andesite. This rock series has been subjected to a major fault movement which was a combination of upthrust and transverse shear. The upthrust took place on the western side of a line trending about 15° west of north and was pivoted at its southern end. This pivot or point of minimum movement is located not far south of the South Arm lease of the

Golden Mile Co. and apparently reaches its maximum in the White Hope. The continuity of this upthrust fault line was broken by the development of a line of shearing at right angles to it.

The effect is that the major fault line from its starting point just south of the South Arm lease runs through the leases of the Golden Mile into the more southerly of the Golden Junction's ground. Thence the transverse shear runs westwards through the Golden Junction, Golden Hill, the southern end of the Golden Stone, Golden Plateau, White Hope South, and Roma North. At this point the upthrust line resumes and again runs 15° west of north through White Hope South, Roma North, White Hope (also known as Gold Top), Cabulcha Enterprise, and White Hope Central. Here it takes a slight bend and assuming an almost due north direction runs through the Sunshine Star and Southern Cloud.

It is clear that the Cracow lodes have been derived from the granodiorite intrusions, and that the porphyry dykes have most probably acted as the main carriers of ore-bearing solutions. The solutions carrying the gold, silica, and other mineral constituents when once fed into the major fault-plane and the transverse shear zone travelled therein and formed the existing lode system. Outside of this fault and shear zone no continuous or large-scale circulation of solutions occurred. Hence only spasmodic and discontinuous deposits can be expected outside such zone. The solutions gave rise to the lode system along the fault and shear zone, mainly by replacement. This replacement varies in amount from quartz stringers in rhyolite or andesite to solid quartz, which represents complete replacement. It is important to note that both rhyolite and andesite have been replaced. Thus the solid quartz at the Warrego (Golden Mile) carrying 8 oz. gold per ton is replaced andesite, while similar quartz in the Golden Plateau with about the same gold content is replaced rhyolite.

The gold content of the Cracow lode system varies from a trace per ton to about 21 oz. per ton. Part of the lode material is clearly unpayable whereas other portions are high-grade. The essential work at Cracow is to explore the defined lode system for the pay-shoots. A number of these have already been located. The pay-shoot may either extend the full width of the lode unit in which it occurs as at the Warrego (Golden Mile) or it may merge into low-grade quartz laterally as in the Golden Plateau.

The pay-shoots conform in dip to that of the lode. Thus in the Golden Mile they dip west at a steep angle. In the Golden Plateau and White Hope South they dip south at 55° to 60°. In the White Hope and Roma North belt they dip west, also at a high angle. The dip of the pay-shoots is thus controlled by the dip of the planes of movement within the major structures. An important characteristic of the pay-shoots is their pronounced pitch. In the Golden Plateau the pitch is 30° towards the west which, combined with the southerly dip of 60°, takes the pay-shoot progressively south-westwards as depth is gained.

Sampling carried out by the various companies and Messrs. A. K. Denmead and J. H. Reid, of the Queensland mines department, indicates that two grades of pay-shoots occur. There is a richer type which shows values averaging upwards of 1 oz. per ton. To this type belongs the No. 1 Shoot of the Golden Plateau, Warrego and Surprise Shoots of the Golden Mile, Sunrise Shoot of the Golden Hill, B.L.D. Shoot of the White Hope South, and the Accumulation Shoot of the Roma North. Disclosed lengths of these shoots range from 20 ft. to 160 ft. Widths range from 1 ft. to 40 ft. Vertical limits have not been established, but the values in the Golden Plateau No. 1 Shoot still persist at 160 ft. depth and those in the Warrego Shoot at 88 ft., at which point values are seen pitching north. Values in these shoots range from 15 dwt. to 21 oz. per ton; averages over appreciable dimensions ranging from 3 to 6 oz. per ton.

The second grade of pay-shoot averages from 5 to 8 dwt. per ton, the range in values being from 4 to 14 dwt. Examples so far located and partially opened up are: Golden Plateau No. 2 Shoot, South Arm Shoot, Mill Shoot on the Normanby, and Surprise No. 2 Shoot. Widths range from 6 ft. in the Mill Shoot, 18 ft. in the South Arm, to 36 ft. at the Golden Plateau. Lengths have not been determined except in the Mill Shoot which on the surface averages between 5 and 6 dwt. over a length of 150 ft. The greatest depth penetrated so far is 100 ft. at the Golden Plateau.

In length the lode system at Cracow along the major structure lines extends for upwards of 15,000 ft. In width the order of magnitude is from 20 ft. to 3,000 ft. Such horizontal dimensions would suggest a vertical continuation to appreciable depths. There is therefore ample justification for believing that the Cracow lode system will live to depths comparable with those of the more productive goldfields of Australia.

With the lodes themselves persisting in depth, what can be expected of the pay-shoots within them? Considerable misconception seems to exist as to what the past few months' work has demonstrated in regard to this. It is important in the interests of future development that the true position in this connexion should be understood. It has been shown in this report that the pay-shoots have not only a dip but a relatively flat pitch. The No. 1 shoot of the Golden Plateau, for example, dips south at 60° and pitches west at 30°. The net result is that the pay-shoot plunges south-west at an angle of about 45°; or in other words, that the bottom of the pay-shoot is one foot further to the south-west for every additional foot sunk vertically. Consequently any vertical shaft or winze must ultimately pass out of the pay-shoot. In the Golden Plateau this is exactly what has happened and the No. 1 shoot has been proved by stepping downward as it is followed in a south-westerly direction. The downwards continuation will be proved by driving west on this No.1 shoot at the 162 ft. level and then sinking. The geological evidence indicates that this trend can be expected to continue. This incidentally means that the Golden Plateau No.1 or rich shoot should pass into the White Hope South lease at a depth of from 300 to 500 ft. The No. 2 or lower grade shoot following the same trend should pass into the Plateau Deeps lease at about the same depth.

Passing now to the persistence of values within the pay-shoots there is the demonstrated fact that values persist to the deepest levels yet penetrated, namely, 162 ft. in the Golden Plateau and 88 ft. in the Warrego. The geological evidence adduced in this report justifies the conclusion that such values can be expected to continue to appreciable depths.

There is no evidence of surface or secondary enrichment on a large scale. The gold-bearing ironstone veins are in order primary hæmatite, and not limonite derived from decomposed pyrite. The kaolin has resulted from the action of ore-bearing solutions rather than from descending surface waters. All these considerations point to the conclusion that the pay-shoots are not merely surface enrichments of unpayable lode material, but are in the main primary in character. Rich patches occur in joint planes and minor fractures throughout the Cracow goldfield. These should not be confused wirh the more important pay-shoots within the main lode system associated with the major structures of the field.

The Cracow field is only in its prospecting stage. Much work has been accomplished under somewhat difficult conditions, but much is yet to be done. There is every justification to push on actively and confidently with this work on the main lode system. The installation now in progress of power plants and rock-drills will greatly facilitate this work. The Cracow field possesses all the essential characteristics of an important goldfield. The present investigation has elucidated the fundamental factors controlling the formation of the lode system and the deposition and distribution of gold values. Work based on these conclusions will result in a closer estimate than is now possible of the potential gold output of the Cracow goldfield.

Xanthates and Flotation.—The results of a study by S. Power Warren on soluble metal xanthates and their effect on differential flotation are given in the *Canadian Mining and Metallurgical Bulletin* for March. The general conclusions reached by the author are—

(1) Investigation has shown that the xanthates of the heavy metals differ greatly from one another in their solubility in the various flotation reagents that are in common use and in others that might be used.

(2) Common practice in ordinary differential flotation of galena-chalcopyrite-sphalerite-pyrite can be explained by chemical data on the solubilities of metal xanthates.

(3) A method for the separation of pentlandite-chalcopyrite-pyrrhotite flotation, which had been outlined from purely chemical data, was confirmed by subsequent flotation test work.

(4) Failure to float gold with chalcopyrite in the ordinary practical separation is explained by the solubility of gold xanthate in cyanide.

(5) A method for the separation of pyrite from gold-chalcopyrite was outlined from chemical data and confirmed by subsequent flotation test work.

(6) Chemical data indicated that pentlandite could be floated ahead of chalcopyrite or, alternatively, that chalcopyrite could be floated ahead of pentlandite. This was confirmed by flotation test work.

(7) The minerals of ores that have been exposed to the influence of oxidation or secondary precipitation do not respond to the treatment outlined as well as do clean unaltered minerals.

Settling Velocities.—A paper by W. W. Rubey on the settling velocities of gravel, sand, and silt particles appears in the *American Journal of Science* for April. The following is the author's own abstract of his argument. He says that the uniform settling velocity attained sooner or later by a falling particle depends upon the resistance offered by the settling medium. For small particles this resistance in turn depends chiefly upon the viscosity of the fluid, but for large particles it appears to be controlled almost entirely by impact. Small rounded quartz grains (very fine sand and silt) fall through water with the velocities given by Stokes' law of viscous resistance, but coarse sand, pebbles, and boulders follow a totally different law.

Granting certain assumptions about the deflection of water, the impact of a rising current required to support a pebble can be deduced theoretically. Published data on settling velocities seem to confirm this deduction and they also suggest the approximate equivalence of these settling velocities to the velocities required to transport pebbles along the bed of a stream (of either water or air). Stokes' law and the impact formula may be combined very simply into a general equation, which contains no empirical constants and accords very closely with published data on quartz grains, but not so closely with data on fragments of galena.

SHORT NOTICES

Shaft Sinking in Running Ground.—G. Heslop gives some notes on sinking through saturated sand at the Cornelia colliery, Transvaal, in the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for February.

Scraper Equipment.—In the *Engineering and Mining Journal* for April L. Eaton discusses the application of underground scraping equipment.

Safety Catches for Mine Cages.—A. L. Egan in *Engineering* for April 21 discusses the inherent dangers of safety catches for vertical mine shafts.

Trolley-Locomotive Haulage.—The costs of trolley-locomotive transport in metal mines are discussed by M. J. Elsing in the *Engineering and Mining Journal* for April.

Mining and Milling Rock Asphalt.—R. C. Fleming describes the mining and treatment of rock asphalt in Utah in *Mining and Metallurgy* for April.

Correlation of Surface and Underground Surveys.—In the *Colliery Guardian* for April 7 there appears the first part of an article by E. Holden describing a method of correlating surface and underground surveys by means of the magnetic needle.

Lake Shore Mine Equipment.—In the *Canadian Mining and Metallirgical Bulletin* for April D. L. Cramp describes the hoist and other equipment at the Lake Shore mine, Kirkland Lake district, Ontario.

Bore-Hole Surveying.—Methods of surveying diamond drill-holes are discussed by W. Rex Storms in the *Engineering and Mining Journal* for April.

Drill Steel.—A paper on drill steels for mining purposes by Dr. W. H. Hatfield was published in the *Bulletin* of the Institution of Mining and Metallurgy for April.

Zinc and Lead in Slags.—G. E. Murray describes the recovery of zinc and lead from blast-furnace slag at Trail, B.C., in the *Canadian Mining and Metallurgical Bulletin* for April.

Treating a High-Acid Gold Ore.—The treatment of a clay-like gold ore occurring at Skouriotissa, Cyprus, which contains 2·5% free sulphuric acid, is described by C. A. Rose in the *Engineering and Mining Journal* for April.

Torsion Balance.—A discussion of the theory of the torsion balance, together with a preliminary

study of a modification of the instrument to decrease the time of gravity measurements is presented by J. W. Joyce in Technical Paper 546 of the United States Bureau of Mines.

Amosite Asbestos in the Transvaal. — L. Reinecke and L. McClure discuss the variations in the quality of amosite asbestos at Penge, Transvaal, in a paper read before the Geological Society of South Africa on January 30.

Lepidolite in South-West Africa.—In the *Transactions* of the Geological Society of South Africa for 1932 W. P. de Kock describes the lepidolite deposits of South-West Africa.

Mining Geology.—H. F. Kendall and J. H. Ffolliott discuss the application of geology to mining work in the Ducktown district, Tennessee, in *Mining and Metallurgy* for April.

Swayze District, Ontario.—W. B. Millar in *Mining and Metallurgy* for April describes prospecting work in the Swayze district of Ontario.

Great Bear Lake.—In the *Canadian Mining Journal* for April C. Riley describes some mineral relationships in the Great Bear Lake area.

Sebastopol-Junee Area, New South Wales.—An account of the geology and gold deposits of the Sebastopol-Junee Reef area, N.S.W., appears in the *Chemical Engineering and Mining Review* of Melbourne for March 6.

Silicosis.—In Technical Paper 545 of the United States Bureau of Mines R. R. Sayers, F. V. Merriweather, A. J. Lanza, and W. W. Adams discuss the incidence of silicosis and tuberculosis among miners in the Tri-State District.

Gold Mining in the Philippines.—A sketch of the history of gold mining in Luzon, Philippine Islands, together with an account of the Balatoc mine, is given by A. E. Lilius in the *Far Eastern Review* for March.

Potash in New Mexico.—An account of the activities of the American Potash Co. in New Mexico, where sylvine is mined, is given in *Chemical and Metallurgical Engineering* for April.

Mineral Resources of China.—In *Mines, Carrières, Grandes Entreprises* for April M. Kuklops discusses the mineral resources of China.

Migration of Oil.—In the *Journal* of the Institution of Petroleum Technologists for April Professor V. C. Illing discusses the migration of oil and natural gas.

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.*

24,303 of 1931 (388,751). Electrical Research Products, Inc., New York. For the fire-refining of copper all or part of the deoxidizing reagent is added to the pure molten copper as it is being poured into a vessel lined with refractory material.

26,148 of 1931 (389,520). R. F. Bacon, New York. Elemental sulphur is recovered from pyrite by smelting a charge containing sufficient carbonaceous material to reduce all the SO_2 formed in the operation.

28,536 of 1931 (388,849). A. Modave, Brussels, and J. Pickin, Leamington. Apparatus for separating dust from gases, consisting of rows of vertical elements of prismatic form arranged in the path of flow, each element having washing liquid fed upon its upper end.

31,946 of 1931 (388,868). H. H. Thompson and A. E. Davies, Birmingham. Finely-divided magnetic materials are separated magnetically by being carried in a flow of water against grooved deflectors arranged between the armature discs and poles of the separator.

32,585 of 1931 (389,567). General Electric Co., Ltd., London. Refinements in the "sand flotation process" for cleaning fine coal.

32,589 of 1931 (389,187). Soc. Anon. des Autolaveurs Bongera, Paris. Washing and sorting apparatus for coal and ores, in which pulp flows along a channel and is compelled to move downwards by siphons arranged in its path, by which heavier components are removed.

21,776 of 1932 (389,005). Intermetal Corp., New York. Finely-divided sulphide ores are chlorinated by passing a mixture of chlorine and oxygen over and through the ore while it is heated at a suitable temperature to bring about the reaction.

23,851 of 1932 (388,674). A.-G., für Bergbau Blei und Zinkfabrikation, Aachen, Germany. Production of zinc from dust or waste materials.

25,661 of 1932 (389,020). Karl Schmidt, G.m.b.H., Württemburg, Germany. Molten aluminium or aluminous alloys are refined by the use of liquid chlorides absorbed in Kieselguhr and placed in aluminium containers.

30,352 of 1932 (389,045). Co. de Prod. Chimiques et Electro-Metallurgiques Alais, Froges, et Camargue, Paris. Beryllium oxide is prepared from its ores by first converting to a double fluoride with an alkali metal, then calcining with an alkali carbonate and washing with hot water.

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.

Phase Rule Studies. By J. E. Wynfield Rhodes. Cloth, octavo, 131 pages, illustrated. Price 6s. London: Humphrey Milford, Oxford University Press.

Our Mineral Civilization. By Dr. Thomas T. Read. Cloth, octavo, 165 pages. Price 5s. 6d. London: Baillière, Tindall, and Cox.

Patents Explained. By H. J. W. Wildbore. Cloth, octavo, 48 pages. Price 5s. London: H. J. W. Wildbore.

First Aid at Mines. Mines Department Safety Pamphlet No. 7. Paper covers, 19 pages, illustrated. Price 3d. London: H.M. Stationery Office.

Quebec: (1) Preliminary Statement on the Mineral Production of Quebec, 1932. Paper covers, 9 pages. (2) Annual Report of the Bureau of Mines for 1931. Part B, Granada Gold Mine and vicinity, by J. E. Hawley; Bell River Headwaters Area—detailing the Pascalis-Louvicourt Gold Deposits, by L. V. Bell and A. M. Bell. Part C, Lake Ostaboning Map-Area, by J. A. Retty; North Shore—Forestville to Betsiamites, by C. Faessler; Bonnecamp Map-Area, Gaspé Peninsula, by J. W. Jones. Quebec: Bureau of Mines.

Kenya: Reports of the Geological Survey. No. 1—The Loldaika-Ngare Ndare Area. Paper covers. Price 50 cents. No. 2—The Lolgorien Area. Paper covers, 10 pages, illustrated. Price sh. 1. Both by R. Murray-Hughes. Nairobi: Mining and Geological Department.

Tanganyika : The Eastern Extension of the Lupa Goldfield (Ipogolo-Sengambi-Shoga). By Dr. D. R. Grantham. Paper covers, 7 pages. Price sh. 1. Dodoma : Geological Survey Department.

Acetone-Air Mixtures : Explosive Properties. By G. W. Jones, E. S. Harris, and W. E. Miller. United States Bureau of Mines Technical Paper 544. Paper covers, 26 pages, illustrated. Price 5 cents. Washington : Superintendent of Documents.

Mineral Resources of the United States, 1931. Part I, pp. 331–349, Tin, by C. W. Merrill. Part II, pp. 237–242, Clay, by O. E. Kiessling and K. V. Herlihy ; pp. 243–250, Sand and Gravel, by E. R. Phillips ; pp. 263–277, Magnesium and its compounds, by P. M. Tyler. Each part in paper covers. Washington : Superintendent of Documents.

California : Mineral Production, 1931, and Directory of Mineral Producers. Paper covers, 229 pages, illustrated. San Francisco : Division of Mines.

Tin—World Statistics, 1933. Cloth, pocket size, 138 pages. Price 2s. 6d. London : Anglo-Oriental Mining Corporation, Ltd.

Coal : A Symposium on the Utilization of Coal. Paper covers, 46 pages. Price 1s. London : British Science Guild.

COMPANY REPORTS

Brakpan Mines.—This company was formed in 1903 and works gold-mining property on the Far East Rand. The report for 1932 shows that 1,277,000 tons of ore was treated in the mill, where 449,519 oz. of gold was recovered, the value of the bullion being £1,931,952. Working costs totalled £1,326,518, or 20s. 9·306d. per ton, giving a working profit of £605,434, equal to 9s. 5·786d. per ton milled. Dividends declared during the year absorbed £357,000, equal to 35%. The ore reserves at the end of the year were estimated to be 2,472,460 tons, averaging 7·74 dwt. in value over a stoping width of 50·38 in., as compared with 2,520,890, averaging 7·78 dwt. over 51·59 in., at the end of the previous year. These figures are based on the standard value of gold and it is estimated that there is an additional 520,650 tons of ore, averaging 4·23 dwt. over 46 in., immediately available. The tonnage developed in the Witpoort Section is 423,790 tons, averaging 8·13 dwt. over 44·32 in. At the end of the year the distance between the face of 7-East haulage in the Witpoort Section and the nearest Brakpan workings was 4,400 ft.

Springs Mines.—This company, formed in 1909, works gold-mining property on the Far East Rand. The report for the year 1932 shows that 905,000 tons of ore was milled, 455,437 oz. of gold being recovered, worth £1,956,589. Working expenses totalled £996,952, leaving a working profit of £959,637, equal to 21s. 2·489d. per ton milled. Dividends declared during the year absorbed £562,500, equal to 37½%. The ore reserves at the end of the year, based on the standard value of gold, were estimated to be 3,838,520 tons, averaging 8·84 dwt. in value over a stoping width of 44·94 in., as compared with 3,452,983 tons, averaging 9·14 dwt. over 48·40 in., at the end of the previous year. Under the conditions now obtaining it is estimated that there is an additional 562,649 tons of ore, averaging 4·24 dwt., which can now be worked at a profit.

West Springs.—Formed in 1918, this company works a gold-mining property on the Far East Rand. The report for the year 1932 shows that 929,000 tons of ore was milled, 225,481 oz. of gold being recovered, worth £967,458. Working expenses came to £759,505 and the working profit was £207,953. Dividends paid during the year absorbed £134,475, equal to 7½%. The ore reserves at the end of the year, based on the old value of gold, were estimated to be 2,765,070 tons, averaging 5·92 dwt. in value over a stoping width of 52·91 in., as compared with 2,737,020 tons, averaging 5·85 dwt. over 53·15 in., at the end of the previous year, while, in addition, it is estimated that there are 832,770 tons of low-grade ore averaging 3·11 dwt.

Daggafontein Mines.—This company was formed in 1916 and works a gold-mining property on the Far East Rand. The report for 1932 shows that the company started production early in the year and by December 31 had treated 476,300 tons, recovering 177,542 oz. of gold, worth £764,083. Working expenses totalled £587,967 and the working profit £176,116. The ore reserves at the end of the year were estimated to be 2,101,980 tons, averaging 7·70 dwt. in value, over a width of 44·46 in., as compared with 2,003,174 tons, averaging 8·09 dwt. over 44·16 in., at the end of the previous year. In addition there is a certain amount of ore available, including ore of 4·2 dwt. and over, which will become payable under present conditions. Arrangements have been made with East Daggafontein Mines, Ltd., and with Vogelstruisbult Gold Mining Areas, Ltd., to drive haulages into these companies' properties and commence development work.

Globe and Phoenix.—This company, formed in 1895, operates gold-mining property in the Sebakwe district, Southern Rhodesia. The report for 1932 shows that 73,486 tons of ore was treated in the mill, 75,039 oz. of gold being recovered. The profit for the year including the sum of £34,915 brought in from the previous account, was £157,074, of which £120,000 was absorbed in the payment of two dividends, equal to 3s. per share, the balance of £37,074 being carried forward. The ore reserves at the end of the year were estimated to be 108,100 tons, averaging 24·70 dwt. in value, as compared with 124,000 tons, averaging 24·30 dwt. in value, at the end of the previous year. The installation of the new power plant was completed during the year, while the sands plant was restarted during the year.

Waihi Gold.—Formed in 1887, this company works a gold mine in the Thames district, New Zealand. The report for 1932 shows that during the year 231,840 short tons of ore was treated, yielding gold and silver worth £490,841. The profit for the year was £149,102, which, added to the sum brought in, gave an available total of £152,948. Dividends paid for the year absorbed £99,181, leaving a balance of £53,767 to be carried forward. During the year 201,907 tons of new ore were developed, the reserves at the end of the year showing 151,080 tons averaging 31s. 11d. per ton in "general account" and 171,060 tons averaging 34s. 8d. per ton in "suspense account." The reserve ore in Junction company's ground was 15,884 tons, of an average assay value of 31s. 6d. per ton. Preparations are in hand for the erection of its dredge by Puket Tin Dredging, Ltd., the shipment having commenced in March last.

Idris Hydraulic Tin.—This company was formed in 1913 and works alluvial tin property in the Kinta

valley, F.M.S. The report for 1932 shows that the company's operations were seriously curtailed by restriction, the output of tin concentrates being 116 tons, as against 312 tons in the previous year. The amount realized for the sale of tin ore was £9,267, equal to £79 15s. 5d. per ton, against £68 11s. 4d. per ton in the previous year. The year's operations resulted in a loss of £3,848, reducing the credit balance brought in to £6,433.

Sungei Kinta Tin Dredging.—Formed in 1925, this company works alluvial tin property near Ipoh, Perak, F.M.S. The report for the year 1932 shows that owing to restriction the dredge only worked about six and a half months, treating 811,450 cu. yd. of ground and recovering 188¼ tons of tin concentrates, which realized £15,526. The year's working resulted in a loss of £2,928 and, after allowing for the balance brought in, there was a debit of £515 to be carried forward.

Tongkah Harbour Tin.—This company was formed in 1906 in Tasmania and works an alluvial tin property at Tongkah, Puket, Siam. The report for the year to September 30 last shows that 2,327,450 cu. yd. of ground was handled by the dredges, recovering 454 tons of tin concentrates, which realized £85 16s. 10d. per ton. There was a loss on the year's working of £16,372, reducing the credit balance brought in to £36,390.

Ooregum Gold Mining.—This company was formed in 1880 and works gold-mining property on the Kolar goldfield, Mysore, India. The report for 1932 shows that 40,468 oz. of gold was produced from 138,700 tons of ore milled, 11,303 oz. recovered from old tailings re-treated, and 452 oz. obtained from 627 tons mined and milled by the Nundydroog company, making a total return of 52,225 oz. The net income was £298,017, while working costs totalled £262,241, leaving a working balance of £35,776. After making various allowances and adding the sum of £13,525 brought in there was a disposable balance of £37,667. Dividends equal to 1s. 6d. on the preference shares and 6d. per share on the ordinary shares were paid, leaving £7,268 to be carried forward. The ore reserves at the end of the year were estimated to be 162,187 tons, averaging 10·18 dwt., a decrease of 11,860 tons, as compared with the figure at the end of the previous year. Apart from this there is 109,800 tons of lower-grade ore, which will be payable with gold at its present price.

Oroville Dredging.—This company was formed in 1909 and holds a controlling interest in Pato Mines (Colombia), Ltd., and a large interest in Bulolo Gold Dredging, Ltd., operating in New Guinea. The report for the year to September 30 last shows that the Pato company treated 3,977,062 cu. yd. of ground recovering gold worth $516,424. In addition 2,364,553 cu. yd. of tailings was re-treated. The accounts of the Pato company showed a profit of £48,863, which, added to the sum brought in and deducting the dividend paid during the year, left £94,525 to be carried forward. The accounts of the Oroville company show a profit of £79,888 to be added to the sum of £87,092 brought in. The dividend paid in April, 1932, absorbed £26,836, leaving a balance of £140,144 to be carried forward.

Tharsis Sulphur and Copper.—This company was formed in 1866 and works cupriferous pyrite bodies in the Huelva district, Spain. The report for the year 1932 shows that shipments of pyrites during the year totalled 597,313 tons, being practically the same as for the previous year. The gross profit for the year amounted to £114,214, from which £74,146 has been deducted for expenses and depreciation, leaving £40,068 net profit, which, added to the balance brought in, gave an available total of £71,037, which has been carried forward.

Mason and Barry.—This company, formed in 1892, works the San Domingos mine, Alemtejo, Portugal, for cupriferous pyrites. The report for 1932 shows that the total quantity of ore broken and raised during the year was 158,265 tons, as against 198,725 tons in 1931, the shipments during the same period amounting to 155,435 tons, against 178,203 tons. The accounts show a loss for the year of £13,219, reducing the credit balance brought in to £4.136.

South Bukeru Areas.—The ore reserves of the South Bukeru company were given in the last issue of the MAGAZINE as 127 tons. This figure refers solely to the company's exclusive prospecting licence and should be added to the reserves of proved ore, equal to 632 tons. After deducting the quota for 1932, equal to 33 tons, the total reserves at December 31 last were 726 tons.

DIVIDENDS DECLARED

Angola Diamond.—1s., less tax, payable April 27.

Broken Hill Proprietary.—1s. (Australian currency), less tax, payable May 24.

Broken Hill South.—1s., less tax, payable June .23

Central Mining.—12s., less tax, payable May 2.

Globe and Phoenix.—1s. 6d., free of tax, payable May 11.

Great Boulder Proprietary.—3d., less tax, payable May 18.

Kaduna Syndicate.—6d., less tax, payable June 1.

Mount Coolon Gold.—1s., less tax, payable June 23.

Murex.—2s., less tax, payable May 8.

Penawat.—3%, less tax, payable May 8.

Petaling Tin.—2½%, less tax, payable May 6.

Sungei Besi.—6d., less tax, payable May 1.

Vereeniging Estates.—6%, less tax.

NEW COMPANIES REGISTERED

Gold Areas of Nigeria.—Capital: £5,250 (1,000 £1 Preference, 4,000 £1 Ordinary, and 5,000 1s. Founders' shares). Objects: To acquire mining rights. Directors: Major Herbert S. Lauriston Scott, Lothian Graham Scott, and Gerhard A. Stockfield.

Gold Options Syndicate.—Capital: £10,000 in 5s. shares. Objects: To carry on the business of mine owners, and to adopt an agreement with Wm. A. Wills.

Southern Siamese Tin Dredging.—Capital: £200,000 in 5s. shares. Objects: To acquire part of the undertaking of the Talerng Tin Dredging. Directors: Victor W. Bowden, F. W. Eve. Office: Lloyds Bank Buildings, 55–61 Moorgate, E.C. 2.