

The Mining Magazine

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EDITORIAL

THE 1930 edition of Skinner's "Oil and Petroleum Year Book" is now published and the present issue is no less valuable than its predecessors as an international work of reference.

THE news that Professor W. W. Watts is to retire from the chair of Geology which he has held in the Imperial College since 1906 will be received with a feeling of regret. He will be succeeded by Professor P. G. H. Boswell, Herdman Professor of Geology in the University of Liverpool, who is an old student of the College.

ELSEWHERE in this issue will be found letters from the Rector of the Imperial College and from Dr. Baring Horwood on the subject of "The Education of the Engineer." Further editorial comment will be deferred for the present, for doubtless others will wish to express their views. It is desirable, however, that correspondents should not narrow down the discussion, but keep it on the broad lines indicated in our editorials.

TWO annual dinners are being held this month. To take them in chronological order, that of the Royal School of Mines is being held at Gatti's Restaurant, Strand, on June 20, at 7.15, under the chairmanship of Mr. Edward Halse, with Professor W. W. Watts and Professor C. V. Boys among the guests, and that of the Institution of Mining and Metallurgy at the Hotel Metropole, Northumberland Avenue, on June 26, at the same hour. The annual general meeting of the latter will be held on the same day, at 3 o'clock, in the rooms of the Geological Society.

ATTENTION was directed in these columns in March, 1928, to the concern felt at the dangers of the introduction into this country of petrol containing lead tetra-ethyl. A Government Inter-Departmental Committee of Inquiry has recently issued its report, which gives this ethyl petrol a clean bill of health. Careful study of this report reveals the fact, however, that the efforts of the investigators have been concentrated on detecting signs of lead poisoning whereas attempts should have been made to ascertain the effects of lead tetra-ethyl—itself a much more dangerous poison—and the extent of them.

COMMENT on the position of silver was made in the MAGAZINE for January last, when the metal price had touched a record low level. Since that time the price of the metal has continued to decline, reaching a new low level of $15\frac{1}{8}$ d. per oz. on June 4. On June 8 a restriction on the import of silver into China was proposed; this would undoubtedly affect Chinese buying, which so far has been the mainstay of the price. In the course of our comments in January it was suggested that the formation of a silver research association might become necessary, and, as it seems prices can only hold by increased metal consumption, the time would appear to be ripe for the formation of such a body.

THE recent movement in Western Australia for seceding from the Commonwealth, on the ground that the grants received are below those to which the State is entitled, has been followed by a representative delegation visiting the Eastern States with a view to securing for Australian gold producers a bonus of £1 an ounce on standard gold won for a period of ten years. In some quarters it is felt there is a connexion between the secession movement and the proposed bonus. Whether this is the case or not, there is no doubt the granting of a bonus would prove advantageous to the mining industry and Western Australia's proportion would be higher than that of the other States, as it is the largest producer.

THE restriction of the outputs of the tin mining companies by 20 per cent. not having met with the results anticipated, further measures are contemplated by the Tin Producers' Association, the council of which has appointed a special committee representative of Malayan, Nigerian, Bolivian, and Dutch interests to deal with the matter. Although the members of the committee are stated to be in full agreement on all points, it has not so far announced its further recommendations. In the meantime there is a movement in the East to close down the British-controlled companies for two or three months, leaving the smaller Chinese-owned properties at work, in order that the large number of coolies should not be thrown out of work.

THE inclusion of tin mines in a Home Office silicosis scheme was dealt with by our Camborne correspondent in the

December issue. Further legislation is now pending more clearly defining the position and at the same time increasing the liability of producers. The new Bill proposes the addition of compensation for partial disablement, the co-ordination of medical arrangements, and the prohibition of employment in tin mines of any workman who has been suspended in pursuance of the scheme or who has refused or neglected to be examined under it. Representations are to be made by the responsible bodies in the county against this additional legislation. Tin producers the world over will be in hearty sympathy, as it affects an industry already afflicted by the low price ruling for this metal.

AMONG the Birthday Honours are several names of interest to the profession. Mr. Basil Mott, on whom a baronetcy has been conferred, received his education at the Royal School of Mines and is a well-known consultant and a past president of the Institution of Civil Engineers. Mr. Herbert Wright, who receives a knighthood, is the chairman of the executive committee of the governing body of the Imperial College, in which capacity he has done good work for many years past. A knighthood has also been conferred on Mr. E. H. Macartney, the Agent General in London for Queensland, and on Mr. A. E. Faulkner, the Under Secretary for Mines at the Board of Trade. Mr. R. R. Simpson, Chief Inspector of Mines in India, receives the C.I.E., Mr. J. A. B. Horsley, Electrical Inspector of Mines in this country, the O.B.E., and Dr. Arthur Winstanley, also on the inspectorate in this country, the M.B.E.

REFERENCE was made in these columns in March, 1927, to a process for treating oxidized copper ores apropos other metallurgical advances. This process has been considerably developed in the interim and following an opportunity of seeing a demonstration on a laboratory scale it is appropriate to give some details. The procedure consists in subjecting the preheated crushed ore to the action of small quantities of two simple reagents, carbon and common salt, cooling the reaction product, and floating the finely divided copper metal which results. It is carried out continuously in the laboratory plant in rotary kiln-type externally heated furnaces arranged in cascade, the reagents in the proportions of 2% carbon and $\frac{1}{2}$ % salt by weight of the ore being added by mechanical feeder at a point intermediate

between the preheating and the reaction kilns. The rotation of the cylinder keeps the charge in motion. As to the nature of the reaction, which it is hardly necessary to add occurs in a reducing or inert atmosphere, this is thought to consist in two essential stages—the conversion of oxide, silicate, and suchlike to cuprous chloride, and the subsequent reduction to metal which appears on the surface of the carbon particles. The metallic copper is often separated as pulverulent segregations, which have suggested the popular name for the process. It has been found that by a slight modification of the process it is equally applicable to mixed oxide-sulphide ores.

The Steam Shovel in Nigeria

The despatch of a new steam shovel to Nigeria has always been a matter of some interest and the extent to which mechanical excavators have been tried on that mining field thus became fairly well known. The measure of success which has attended their employment, however, has always been difficult to determine as but little information has been forthcoming from those able to record the progress of operations. The paper of Mr. W. E. Sinclair, therefore, on "Steam Shovel Mining in Nigeria," which was discussed at the May meeting of the Institution, forms a welcome contribution to our knowledge of this matter. In the absence of Mr. Sinclair, who was on his way to this country from South Africa, the paper was briefly introduced by Mr. Humphrey Morgans and gave rise to a fruitful discussion. In the paper—extracts from which will be found elsewhere in this issue—the history of each excavator appearing on the Plateau is briefly recorded by the author, from the first dragline installed at Liruei-n-Kano and the first shovel on Keffi Consolidated, and the working difficulties encountered in each case are outlined, together with a record of faulty lay-out and the manner in which such difficulties and mistakes might be overcome or rectified. Working costs are then briefly reviewed and, finally, the present position of the use of mechanical excavators in Nigeria is surveyed.

After the introduction of the paper by Mr. Morgans, the wisdom of using steam shovels in Nigeria was strongly questioned by Mr. Brodigan, who, in the first place, pointed to the large capital expenditure involved in their installation. He referred also to the scarcity of white labour on the Plateau and pointed out that the dependence

of work in hand on the shovel operator rather militated against efficiency and made it imperative that native labour should be trained as speedily as possible in the handling of the machines. Mr. Brodigan also deplored the lack of exact figures in the paper and suggested that mechanical excavators were not a success on the field. Several other speakers rather supported Mr. Brodigan's attitude, which was opposed, however, by Mr. Trewartha-James, who called attention to that section of the paper where the author lays down that in each case the excavator had done all that was demanded of it. Mr. Trewartha-James was supported by Mr. W. Barnes, of Ruston-Bucyrus, and by Mr. D. J. Ringwood, of Ransomes and Rapier.

Any attempt to assess the degree of success which has attended the use of mechanical excavators in Nigeria must take account of the fact that on this field the use of machinery has ever been considered as foredoomed to failure and even at the present time the installation of any new mechanical device is viewed with distrust. In such an atmosphere it is not surprising that information about the use of the Nigerian shovels has been somewhat conflicting. To an outside observer this attitude of distrust is, perhaps, difficult to understand, as an examination of the work of mechanical excavators in other parts of the world shows that, correctly applied, they could well do similar work in Nigeria. If a steam shovel can remove thick overburden from a thin seam of coal in the U.S.A. and re-pay the large capital expenditure involved there is no apparent reason why similar work could not be done in Nigeria over a tin-bearing gravel. Again, an examination of the finances of Nigerian companies makes it apparent that in many cases the capitalization could only be warranted by large outputs and that such large outputs could only have been ensured by the installation of mechanical excavators capable of handling enormous yardages of overburden. As was noted during the discussion of Mr. Sinclair's paper, there have been no faults in the machines working on the Plateau, which are all doing work which would otherwise call for enormous supplies of water and labour, with neither of which, as the author pointed out, is Nigeria plentifully endowed. It is evident, however, that, although no fault can be found with the machines, their installation on the field has not always been carried out in an efficient manner. Usually too much work has been

demanding of them—in other words, a machine of too small a capacity has been installed—the lay-out of the work has been faulty, and the management of white operators has not always been carried out with the firmness and tact demanded. Finally, it would appear that, whilst there is nothing wrong with the shovel in Nigeria, its installation and handling have not always been all that could have been desired.

The Future of the Rand

The life of the Rand goldfield—or, as those in the insurance world would express it, the expectation of life—has for long been the concern of those who for one reason or another are dependent on the maintenance of its prosperity. The time following the publication of the reports of the big corporations controlling the operations of this field seems to be an opportunity for some further consideration of this always interesting and deeply significant subject. In particular some of the observations made by the chairman of the Central Mining group provide material for comment and discussion.

Sir Sothern Holland, recording his impression of a recent visit to South Africa, was disposed to deplore the want of thought or trouble being given to the problem, which the Union will have to face, of the progressive contraction of the industry and this, moreover, in spite of repeated warnings from those competent to judge the trend of events. As he pointed out, in an age when there is over-production of almost every raw material the demand for gold persisted and, in fact, tended to increase. This being so, and notwithstanding the industrial development of the Union as a whole, that country is still dependent pre-eminently on the prosperity of its gold-mining industry. He referred also to the tendency in some quarters there to regard the platinum-producing industry as capable of taking the place of the declining older industry, but the statistics enabled him effectively to dispose of this fallacy, for such it is. Making the most generous allowance for increased consumption at a lower price, it can be shown that if South Africa produced the whole of the world's requirements of platinum the revenue to the State would be between three and four million pounds only, or rather less than the value of the output of the Crown Mines alone. Further, employment would be found at best for some 1,000 white men and 10,000 natives and the plant and stores required would be

less than half that needed to equip and run a gold mine of the size of the properties controlled by the company mentioned. It should be remembered that the Central Mining Corporation is itself interested in platinum production, so that these remarks are to be regarded as quite unbiased. Coming to the gold mines of the Witwatersrand and the steps necessary to help and maintain the industry so important to South Africa, and in turn to the Empire as a whole, these can only take the form of reduction of working costs to bring more and more low-grade ore into the region of payability. Various means suggest themselves and others will, no doubt, be found when the question comes to be examined more closely, as it will sooner or later. The Government might sacrifice some revenue to-day and the colour bar restrictions might be somewhat modified, apart from technical improvements tending to bring down expenditure, while it is felt that the opening of new areas in the Far East Rand would be facilitated by some revision of the Mining Leases Act.

Our Johannesburg correspondent in his letter last month recorded a debate in the Union Parliament, at the instigation of Sir Robert Kotze, which was aimed at riveting attention on this matter and as a result a Government investigation has been promised. Sir Robert disclosed that a reduction of costs would have the effect of making workable so much more ore that the increased prosperity to the industry would result in the State being reimbursed for any sacrifice it might make. At any rate, a sufficient case for enquiry seems to have been made and the forthcoming deliberations will be followed with close attention, not only in the Union, but also in this country.

Empire Unity

Much publicity has lately been given to schemes for the consolidation and development of the Empire and the appeal for Free Trade within its confines is becoming a political issue of the first importance. The ideal of an Empire as a closely-knit economic whole has been set up and is finding a ready acceptance among an increasing body of people whose enthusiasm is not easily damped. The practicability of this worthy ideal is beyond our province to discuss, but, so far as readers of the MAGAZINE are concerned, it will be recognized that the mining engineering profession for its part is striving through the medium of

triennially-convened congresses to cement the bonds of Empire in the mining and metallurgical industries. Amid all this semi-political, semi-economic, complexity there is an aspect of the matter which seems to be of specific interest to the engineer himself, bearing on the development of the Empire's mineral resources. It has been said that the employment of foreign capital for the exploitation of colonial mineral wealth is to be regarded as anything but disadvantageous, since the "foreigner who is assisting in the discovery and mining of natural resources is adding to the wealth of that country"—to quote from the MAGAZINE of February last.

Fundamentally, as an economic theory, the foregoing is a sound view that will, as we have said on a previous occasion, be generally endorsed. There is, however, a concomitant of foreign financial participation which may have undesirable effects. Viewed from the broad standpoint of purely economic reasoning, the opinion about to be expressed may be regarded as parochial, but it is nevertheless of such importance to mining men that in their interest it may well be advanced. The question of the desirability or otherwise of the enlistment of foreign capital for the conduct of operations on British territory largely depends on how far this participation carries with it the power to control those operations. Foreign control *per se* may be unobjectionable economically. When, however, it carries with it the preferential selection of technical executives of other than British nationality, sometimes regardless of efficiency, it seems time to take notice. This may be regarded as a charge of administrative inefficiency, but, human nature being what it is, does it not happen that selections are often made from motives of sentiment? This is a contingency that has to be faced and, in fact, has been faced in isolated instances.

A repercussive effect of the employment of foreign technical men in mining and metallurgical activities in the Dominions and Colonies is sometimes to be found. Trade follows the flag; the manufacturer is heavily indebted to the pioneer and the colonist. These somewhat sententious observations have their modern equivalent, inasmuch as machinery is said "to follow the engineer." Here again sentiment plays a considerable part and the makers of mining plant and machinery in this country would feel more confident of receiving consideration from executives of their own nationality.

REVIEW OF MINING

Introduction.—Business continues to be very dull and there are as yet few signs of a revival. The issue of the Simon Report will at this stage only add to the Indian confusion, although, after consideration of its contents, it is to be hoped that conditions in that country will improve. Such an improvement would give a much-needed impetus to trade in this country.

Transvaal.—The output of gold on the Rand during May was 876,893 oz. and in outside districts 39,320 oz., making a total of 916,213 oz., as compared with 868,606 oz. in April. At the end of May the number of natives working in the gold mines was 202,182, as compared with 202,434 at the end of April.

At the annual meeting of the New Steyn Estate Gold Mines, held in Johannesburg, it was announced that the company and the liquidators of Roodepoort United were considering a fusion of interests in order that a scheme might be launched when conditions are favourable.

The first report on the work of the Waterval (Rustenburg) Platinum Mining Company, which covers the period of eight months since production commenced, shows that 78,400 tons of ore, averaging 7 dwt., was treated for a total recovery of 11,231 oz. of platinum group metals. Gravity concentration only was employed, but experiments on the treatment of tailings by a flotation process have had encouraging results. The company sold 7,654 oz. of metal, which realized £73,424, or £9 11s. per oz. The metals recovered contained over 80% platinum, 14% palladium, and 5% gold. The reef is very narrow, only 16 in. in stoping width, and an underhand resuing method of mining has been found suitable for extraction.

Southern Rhodesia.—The gold output of Southern Rhodesia for April was 45,806 oz., as compared with 45,511 oz. in March and 48,210 oz. in April of 1929. Other outputs in April were: Silver, 5,989 oz.; copper, 143 tons; coal, 88,808 tons; chrome ore, 21,357 tons; asbestos, 2,516 tons; mica, 1 ton.

Intensive prospecting work in Southern Rhodesia will be undertaken by a new company, the Victoria Prospecting Co., to which a special mining grant has been made by the British South Africa Company, with the approval of the Government of Southern Rhodesia. The new company will have a capital of £150,000 in 300,000 shares of 10s. each and the managers and consulting

engineers are Rhodesian Anglo American, Ltd. It is understood that the greater part of the capital will be subscribed by the principal Rhodesian and Transvaal mining and finance groups. The grant itself covers an area of approximately 9,000 sq. miles, situated to the east and south of Fort Victoria and extending to the Portuguese frontier, and will thus include portions of the Victoria, Ndanga, Bikita, and Melsetter districts.

Northern Rhodesia.—The report of Rhodesian Anglo American, Ltd., for the period from the incorporation of the company (December 8, 1928) to March 31 last shows a gross revenue from all sources of £746,425 and an unappropriated profit of £323,603. The company has important holdings in the Bwana M'Kubwa Copper Mining Co., Rhodesian Congo Border Concession, Loanga Concessions, Rhodesia Broken Hill, and the British South Africa Company.

A progress report issued by Roan Antelope Copper Mines, Ltd., states that during the three months ended March 31 last the station on the 420 level of the Beatty shaft was completed and sinking operations resumed. The erection of new steel headgear at No. 2 shaft is in hand and a 500-gallon centrifugal pump has been installed in the old 420 pump station. In addition a new sump and a station for two similar pumps are being prepared. The sinking of the upper portion of No. 5 Supply Incline, which will serve the flat stoping area in the "nose" of the syncline, has been started from surface; lower portions will be raised. Improved labour available towards the end of the quarter gave an impetus to the work in hand, the total compound strength increasing to 3,860 "boys" at the end of March. At an extraordinary meeting held on June 10 the creation of £2,500,000 debenture stock was authorized, arrangements having already been made for the issue of £1,500,000, which will be redeemable in 15 years and carry interest at 7%, in addition to having option rights.

The report of N'Changa Copper Mines, Ltd., for 1929 states that work during the year was confined to drilling operations on both limbs of the syncline and to a limited amount of underground work on the northern limb. On the River Lode the vertical shaft was sunk to 634 ft., but cross-cutting has been suspended owing to lack of power. The first shaft, No. 10, has been started on

the "New Discovery" area and the installation of power-plant is in hand. The present drilling policy is being directed towards the discovery of sulphide ore and work is in progress which will prove whether the rich sulphides encountered on the lower horizon in the adjoining area of the Rhodesian Congo Border Concession extend into the N'Changa area. About the middle of May, however, shareholders were informed of the results obtained from bore-hole B.39 which showed that the lower banded shale horizon at this point is 12 ft. thick, averaging 9.5% copper, of which only 25.3% is in the form of sulphide.

A progress report issued by Mufulira Copper Mines, Ltd., which deals with the work done to March 31 last, shows that considerable difficulty is being experienced in the conduct of mining operations owing to water. No. 2 shaft was stopped early in February, while No. 3 was sunk to the 620 ft. level and driving commenced on the 380 ft. level. Owing to the presence of water under pressure, however, provision will have to be made for pumping-sumps and the nature of the ground is making this difficult. No. 4 shaft was advanced to the 433 ft. level, 70 ft. of driving being done at the 250 ft. level for sumping purposes, and No. 5 shaft was sunk to 90 ft.

Shareholders of the Rhodesian Selection Trust have been informed of the results from two new bore-holes. Bore-hole No. 3 at Kasaria, on the Luansobe special grant, entered ore at 955.5 ft. and passed through 3.9 ft. true width of sulphide ore, averaging 5.42% copper. On the Chambishi special grant bore-hole No. 35 entered ore at a depth of 1,180 ft. and showed 25 ft. true width of sulphide ore averaging 6.85% copper, of which the lower 107 ft. averaged 12.78% copper.

Uganda.—An offer to shareholders of Kagera (Uganda) Tinfields, Ltd., made on behalf of the Billiton Tin Company, to take their shares at 7s. 6d. per share, provided that the holders of 150,000 shares accepted the offer by June 2, has been accepted. The Billiton Company is to provide the Kagera company with sufficient capital for development during the next two years.

Nigeria.—During the year ended October 31 last the output of tin concentrates by the Kaduna Syndicate was 464 tons, as against 382½ tons in 1927-28, the net average price realized being £126 17s. 6d. per ton, against £140 1s. 9d. The profit was increased from £17,201 to £26,218, while a similar

dividend of 20%, absorbing £8,000, was paid during the year. The company is interested in Mavoc, Ltd., prospecting in Sierra Leone, and in East African Explorers, Ltd., which has applied for prospecting and mining rights over tin-bearing ground in Nigeria.

In spite of a reduced output of tin concentrates—288 tons, against 310 tons for 1927-28—the profit of the Kaduna Prospectors for the year ended October 31 last was £13,138, as compared with £10,085 for 1927-28. Dividends totalling 10%, absorbing £3,000, have been paid, as compared with 20% in the previous year. The price realized for its product was £131 17s. 10d., against £145 11s. 1d. It is proposed to increase the capital of the company to £60,000 by creating 80,000 new shares of 5s. each, although any issue in the near future is not contemplated.

Australia.—An issue of £1,500,000 8% Convertible and Redeemable Debenture Stock was successfully made by Mount Isa Mines, Ltd., towards the end of May. The report of the technical committee, which was attached to the prospectus of the issue, was noticed in these columns last month.

In a circular to shareholders of the Roper River Land and Minerals Company, Ltd., it is stated that an option has been acquired over lead properties situated in the Camden District of New South Wales. The properties, which cover 527 acres, comprise the Colon Peaks, Silver Peaks, and Silver King leases. The lead mineral is galena and is said to contain values in gold and silver. A report on the property has been made by Mr. F. B. Trude and the purchase price is £16,667 and £2,000 payable out of the proceeds of the first sales of ore produced. To provide the necessary working capital of £20,000 the company will be reconstructed, shareholders being given the right to apply for two shares of 5s. each in the new company, with a liability of 1s. 3d., for each 10s. share now held.

During 1929 the mill of the Sons of Gwalia treated 118,328 tons of ore and 43,512 tons of accumulated sands and slimes, the total output of gold being 30,929 oz., which realized £131,161. Working costs were kept low, but mainly due to the grade of ore treated there was a loss for the year of £2,678. Severe temperature conditions at depth continue to delay the opening up of the lower levels.

Modifications in the original plans for the development of the Wiluna Gold Mines and the decision to spend more money on accommodation and amenities for work-people made it apparent that more capital would

be required. Towards the end of 1929 it was estimated that £550,000 would be necessary. Of this sum the West Australian Government has unconditionally guaranteed the provision of capital and interest on £300,000 6% seven-year notes, which have been placed in London. It is intended to give shareholders the opportunity of participating when it is decided to issue the balance.

Malaya.—During 1929 the Tanjong Tin Dredging, Ltd., treated 1,420,350 cu. yd. of ground, the output of tin ore being 372 tons, as compared with 437 tons in 1928. The total revenue was £46,391 and the working profit £23,113, the latter comparing with £34,114 the year before. Dividends totalling 20% absorbed £16,000, against £20,000 the previous year.

The output of Kinta Tin Mines for 1929 was 368½ tons of tin ore from 962,500 cu. yd. of ground. The total revenue was £46,341 and the working profit £30,182, as compared with £33,244 in 1928. Dividends paid during the year absorbed £24,000, equal to 20%.

During 1929 the output of Idris Hydraulic Tin was 450 tons, or 102 tons less than in 1928, and the average price realized per ton was £114 6s. 6d., as compared with £125 4s. 10d. The revenue fell from £69,286 to £51,746 and the profit from £47,584 to £30,608. Dividends at the rate of 20% absorbed £24,000.

India.—The report of the Indian Copper Corporation for 1929 states that 80,151 short tons of ore was mined during the year and 1,635 tons of refined copper was produced. The ore reserves were increased by 42,111 short tons and at the end of the year were estimated to be 797,741 short tons averaging 3.32% copper. Sales of kyanite from the Kharsawan area increased from 1,951 tons to 3,432 tons. The profit for the year's working was £45,415.

Burma.—At an extraordinary general meeting of Anglo-Burma Tin to be held this month it will be proposed that each of the unissued shares of £1 be divided into four shares of 5s. each, and that the capital be reduced from £250,000 to £121,000, divided into 484,000 shares of 5s. each. When the reduction has been confirmed the capital will be increased to £250,000 and at the same time it is proposed to create £80,000 in debentures.

Spain.—The Esperanza Copper and Sulphur Company reports an increase in the production of pyrites during last year, the

development of the Esperanza mine below the bottom level being promising. In Cyprus a start was made with the re-opening of the Lymni mine of the Cyprus Sulphur and Copper Co. and work is stated to be proceeding satisfactorily. The profit for 1929 was £20,799 and the dividend of 7% recommended will absorb £19,031.

Anglo-Oriental Mining Corporation.—At an extra-ordinary general meeting of the Anglo-Oriental Mining Corporation, held at the close of the annual general meeting last month, the proposal to increase the authorized capital of the corporation to £1,750,000 by the creation of 1,000,000 new ordinary shares of 5s. each was approved.

Central Mining and Investment Corporation.—The acquisition of an interest in two tin-mining companies operating in Bolivia, following a report by Dr. Malcolm Maclaren, was announced at the annual meeting of the Central Mining and Investment Corporation, which was held last month. A mining engineer from the Rand has taken over the management of the properties and a comprehensive scheme of development is being prepared.

Consolidated Gold Fields of South Africa.—The fusion of three investment trust companies largely interested in the South African mining industry has been sanctioned by shareholders of the respective undertakings—the Consolidated Gold Fields of South Africa, the South African Gold Trust, and the Amalgamated Mining Trust. Consolidated Gold Fields will acquire the assets and undertakings of the other two companies by an exchange of shares, and will increase its First Preference capital by £500,000 and its Ordinary Capital by £1,000,000.

Consolidated Tin Smelters.—At the statutory meeting held at the end of May it was announced that the merger contemplated on the formation of the company in January last had been ratified by the shareholders. It will be remembered that a necessary condition for ratification was that the holders of 90% of all classes of shares in each of the amalgamating companies—the names of which were given in the MAGAZINE for January last—should agree to exchange their shares.

Murex, Ltd.—In order to acquire over 99% of the shares of Alloy Welding Processes, Ltd., the board of Murex, Ltd., propose to increase the capital of the company by creating 100,000 new shares of 10s. each.

OBSERVATIONS ON THE GEOLOGY AND MINES OF THE BELGIAN CONGO¹

By G. VIBERT DOUGLAS

In this article the author, who is the Chief Geologist to the Rio Tinto Company, gives some notes taken during a recent visit to the Katanga.

GENERAL GEOLOGY.—In discussing the general geology of the Katanga, it is necessary to consider a broader area than that prescribed by the international boundary and it will be necessary therefore to make frequent mention of the parts of Northern Rhodesia which have a bearing on the subject.

similar folds in Northern Rhodesia, while the nappes and thrust blocks of the Alps find their equivalent in the Belgian Congo.

Following, or during, this period of crustal deformation there was a period of igneous activity, during which acid and basic rocks were injected into the overlying formations. During the closing stages of this activity



FIG. 1.—FLOODED OPEN-CAST OF THE ETOILE DU CONGO MINE.

The sedimentary rocks of the Katanga and parts of Rhodesia would appear to have been laid down in a great inland basin as fresh water shallow deposits. Following its deposition and the later uplift which drained the basin, there ensued a period of mountain building in which the rocks were folded and crumpled. The axis of this line of mountain-built structures trends N.W.—S.E. In Rhodesia the folding was comparatively gentle, whereas in the Katanga the rocks were not only folded but were thrust over the younger formations in a number of places. The directions of the forces which produced this movement were either from the N.E. or S.W., depending on whether one considers the operation as one of under-thrusting or overthrusting.

An European parallel may be drawn between the African structures and those of the Alps and Jura. The anticlines and synclines of the Jura can be likened to the

the mineralization was supposed to take place. It should be noted here that there is a difference of opinion amongst the geologists of the Congo and those of Rhodesia as to the time of this mineralization. A discussion of this point will be found in a later section.

Following the events as just outlined, erosion reduced the whole area to a peneplain. In the course of this erosion the crests of many of the anticlines and nappes were removed, and in places the basement rocks were exposed. Where sulphide mineralization existed the action of the surface waters and of the gases of the atmosphere began to alter the original composition of the minerals contained in the rocks. The considerable depth to which oxidation has penetrated in the areas here considered points to the fact that arid conditions must have prevailed.

At the present time (1930), the geographical limits of these folded rocks have only been determined in a very general way. In the Congo their range is from the

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south-east corner of the Belgian Territory to some point a little to the west of Musonoi or the centre of the western group of mines. This stretch is approximately 400 miles. In Northern Rhodesia the potential range of the copper-bearing series is of the order of 200 miles. In making these statements two facts must be borne in mind—first, the mapping of the rocks in Northern Rhodesia is by no means complete, and secondly, erosion having cut down the series to a much greater degree south of the frontier, there is less continuity. This lack of continuity means that there are only patches of the copper-bearing series left. It is true that some of these patches are of considerable extent, but, nevertheless, there is not the evident continuity of the beds such as is seen in the Katanga. This is one reason for believing that the mineral deposits of the Katanga are potentially greater than those in Rhodesia.

In the accompanying table the formations occurring within the Katanga system are shown as set out by Robert and Van Doorninck.

MINERALIZATION.—The problem of the relation of mineralization to the period of mountain building might appear at first sight to be only of academic interest. It has, however, a very live economic aspect, especially to those in the Belgian Congo, as the following discussion will reveal.

The problems can be briefly stated thus: Were the ores introduced into the rocks of the mine series of the Congo and the copper bearing series of Northern Rhodesia, before or after those rocks were crumpled, and were the ores in the two countries introduced at the same time? Also, are the ores epigenetic or syngenetic with the beds in which they are formed?

Taking these problems in the reverse order to that which they are stated, it may be said that the geologists in Northern Rhodesia and the Congo consider that the ores in the mines of this large area are epigenetic, that is to say they were introduced into the beds after these beds had been laid down and consolidated. Some members of the XV International Geological Congress, however, notably Professor Schneiderhöhn, considered

TABLE OF GEOLOGICAL FORMATIONS IN THE BELGIAN CONGO

<i>M. Robert's Column through Moachia Anticline.</i>			<i>Van Doorninck's Column.</i>		
		<i>Mtre.</i>			<i>Mtre.</i>
Upper Kundelungu.	Lime & sandy schist	10	Plateau Arkose.	Arkose	200
	Pinkish limestone .	15			
	Little Conglom.	15			
Lower Kundelungu.	Sandy, felspathic limestone	40	Katete.	Sandstone, Shale, Limestone, Little Conglom.	
	Argil. scht.	200	Lime Shale Series.	Lime Shales	3,000
	Kakontwe limestone and calcar. scht..	50		Kakontwe limestone	
				Calcareous shales.	
	Great Conglom.	350	Katanga Tillite.	Conglomerates	200
Système Schisto-dolomitique cherteux (= Moachia).	Fels. S.S.	5		Shales	800
	Argil. scht.	20		Arkose	100 to 500
	Fels. S.S.	20		Lime shales	
	Argil scht.	200		Oolites.	
	Black scht.	100	Mwashya.		
	Limestone and lime scht.	100			
	Conglom.	1.5			
Série des Mines.	Green, grey limestone sometimes schistose & sandy	60			
	Oolites, jasper and hæmatite	10			
	Dolomite	200	Série des Mines.	The same as in Robert's Column.	
	Dolomitic shales, Cellular quartzite, Feuilletées or banded quartzite.	to			
	Inferior or lower shales	400			

SYSTEM OF THE KATANGA

N.B.—Geological columns of other writers are given in Van Doorninck's Memoir.

that the ore was syngenetic, that is, laid down as an integral part of the sediments.

The field evidence seems, in the opinion of the writer, to be in favour of an epigenetic origin. Some of the reasons are:—

(a) The association in Rhodesia between the ores, the sediments, and the intrusive bodies of granite and pegmatite. There is a definite pattern on the geological maps of the M'Kana Mine, the Roan Antelope Mine, Mufulira and N'Changa. Where the copper bearing series is in close proximity to the

phenomena can be seen at the Roan Antelope mine.

(e) There appears to be a definite connexion in Northern Rhodesia between the mineralization and drag folds. This point has been especially emphasized by Dr. J. A. Bancroft.

Regarding the question of whether we are dealing with two periods of mineralization or one period, it may be stated that owing to the association of the ore minerals in both countries the probability is in favour of one

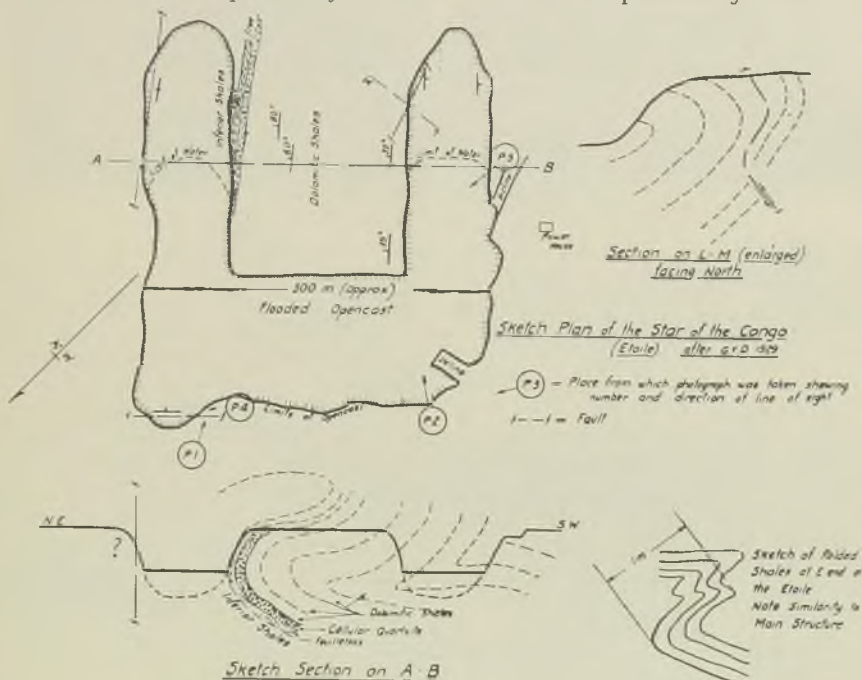


FIG. 2.

intrusive granites or is caught between two boss-like bodies, as at N'Kana and the Roan, there the ore is found to be present. In the Congo and at Bwana M'Kubwa this field relationship is not apparent, possibly because the granite masses, if present, have not been revealed by erosion.

(b) The microscopic evidence is in favour of mineralization later than the formation of the beds.

(c) At some of the Northern Rhodesian mines the mineralization is not confined to any one bed, but jumps from one horizon to another along the same flank.

(d) In the opencast at Luushia a veinlet of chalcopyrite and kyanite (disthene) could be seen cutting the shales normal to their bedding planes. On a smaller scale, similar

great metallogenetic epoch. The association of minerals containing copper and cobalt is somewhat rare, and is common alike to the Katanga and Rhodesian deposits.

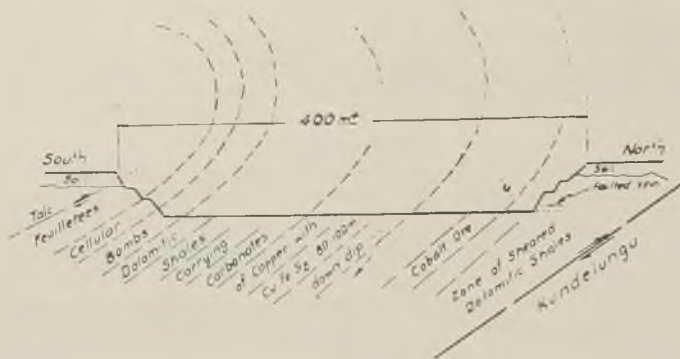
The major problem of the time relations of mountain building and mineralization remains unsolved. According to the geologists of the Union Minière du Haut Katanga, the ore minerals were introduced into the rocks of the Série des Mines before mountain building took place.

The arguments in favour of this contention may be stated as follows. Firstly, the mineralization is in the beds of the Mine Series and is uniformly distributed. This is the argument advanced by M. Richet. Secondly, the faults and thrust planes are not mineralized. Although there is a

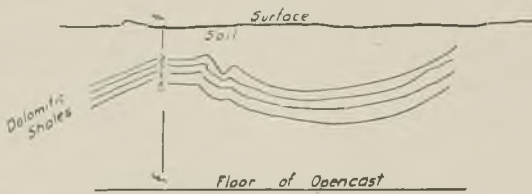
tremendous amount of talc developed in the thrust planes, which will make these planes almost impermeable, yet the fact that the faults, as distinct from the thrust planes, are not mineralized presents a formidable argument in favour of the Belgian contention. It may be noted here that the writer found on the dump at the Etoile a specimen of a distinct breccia, in which the angular fragments of rock were cemented by copper carbonates and chrysocolla. He was not able to find the place where the specimen came from. This find, however, casts some doubt on the validity of the second argument. Thirdly, the Kundelungu shales, which are

tion was accompanied by silicification. The resulting quartz veinlets are found only in the Série des Mines. This statement precludes the possibility of the ore minerals having been completely hacked out of the crushed zones, thereby leaving no trace.

The general opinion of the geologists of Rhodesia is that the ore-deposits are post mountain building, a view diametrically opposed to that of the Belgians. The evidence for this view may be summarized as follows: Firstly, fresh pegmatites are to be seen in some of the Rhodesian mines cutting the beds of the Bwana M'Kubwa series. It is difficult to conceive that these could have



Sketch Section of Ruashi Opencast facing west about midway on the Axis



Note Ruashi is one of the large producing mines of the Congo

Sketch Section at West End Ruashi

FIG. 3.

younger than the Mine Series, but upon which the Mine Series have been thrust, are supposed to be barren. In one place in Kipushi, this statement is false, for if one can believe the rumours from this sanctum of secrecy the ore is there in the Kakontwe Limestone of the Kundelungu. Furthermore, the shales of this age below the Mine Series have not been explored to any extent. Finally, in places, as in the Hospital Pit at Luushia, the Mine Series carrying sulphides as well as oxides have strikes normal to the thrust planes. In a number of places sulphides have been proved by drilling down the dips of these beds. Furthermore, the mineraliza-

tion has already been indicated, the ores are connected with the cooling phases of the granitic magma from whence also came the pegmatites. Therefore, if the pegmatites are later, so also are the ores. Secondly, it has been previously mentioned that the ores are associated with drag folding. This constitutes a very strong proof for a mineralization later than the folding. Finally, the veinlets in the open cast at Luushia, which have been referred to, are also positive evidence.

In reviewing these "pros" and "cons", it must be admitted that there is strong

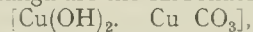


FIG. 4.—RUASHI OPEN-CAST—FACING EAST.

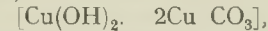
evidence on both sides; however, it will be seen that the Rhodesian evidence is of a more positive character than the Belgian. The following conclusion may therefore be made. It is extremely unlikely that we are dealing with two periods of mountain building. It is also unlikely that there have been two periods of mineralization on account of the rare association of minerals of copper and cobalt. Therefore the evidence, although conflicting and difficult of interpretation, points on the whole to an epigenetic and post-tectonic period.

Turning from these rather theoretical

but nevertheless important considerations to the facts concerning the minerals, it must be mentioned that most of the ores mined in the Katanga are the carbonates malachite,



and azurite,



and the silicate chrysocolla. This mineral is of indefinite composition, being really a metacolloid, or perhaps a solid solution of diopside in gelatinous silica.

There are lesser amounts of the following minerals also present:—

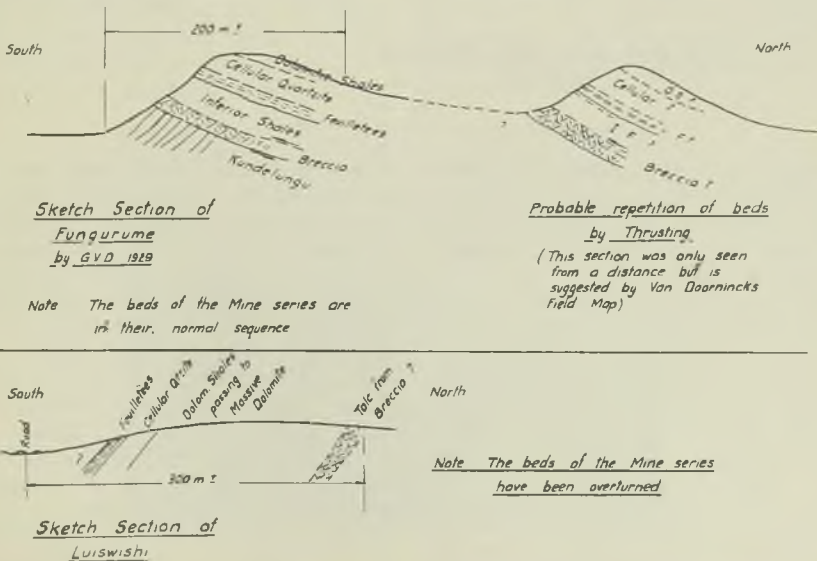


FIG. 5.

- Shattuckite $[2.CuSiO_3.H_2O ?]$
- Planchéite $[2.CuSiO_3.H_2O ?]$
- Katangite . Probably similar, but paler in colour than Planchéite.

There are also still lesser amounts of:—

- Cuprite $[Cu_2O]$
- Tenorite or Melanconite $[CuO]$.

The rarer minerals found include:—

- Torbernite $[Cu(UO_2)_2P_2O_8.12H_2O]$
- and Cornetite $[(CuOH)_3PO_4]$.

dip in the beds of the Mine Series, sulphides are known to exist, and it is therefore highly probable that the carbonates and oxides represent a concentration of these oxidized sulphides in favourable zones. The greater development of carbonate ore in the Congo than in Rhodesia, is undoubtedly due to the fact that in the Congo the parent rocks are much more calcareous or dolomitic.

In some instances the carbonate ores are not found *in situ*; they have been transported and deposited in sub-surface loci,

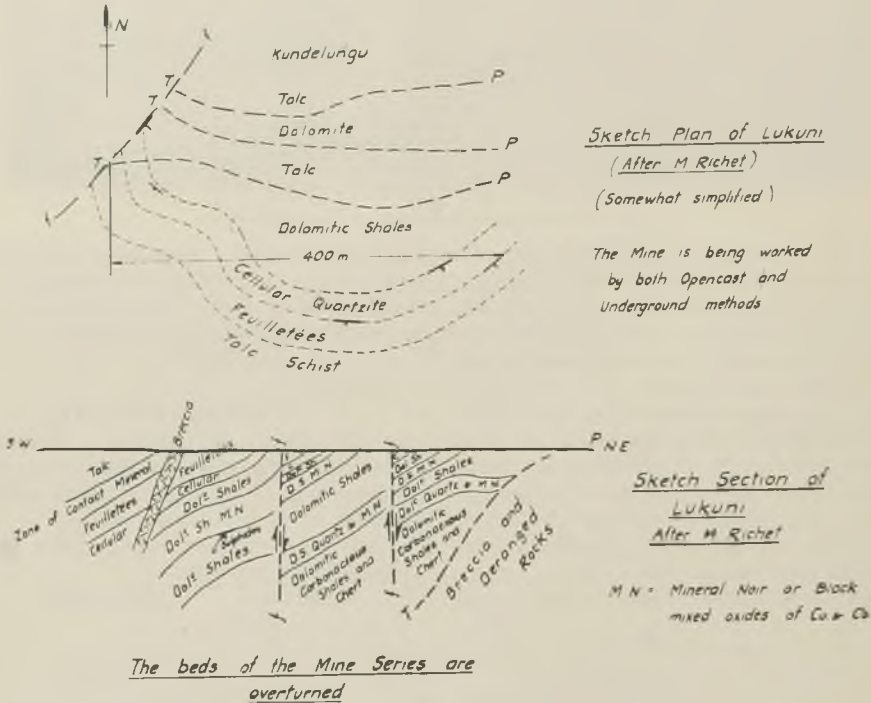


FIG. 6.

In certain of the mines, notably Chinkolobwe and Luushia, various ores of the radioactive elements are found: Pitchblende (Uraninite), Becquerelite, Sodidite, Curite, Schoepite, Gummite.

Commonly associated with copper minerals there are a number of cobalt minerals among which may be mentioned:—

Cobalt oxide: Probably a composite product, including various cobalt oxide minerals. Perhaps Asbolite.

Linnaeite: $[Co_3S_4]$.
 Carrollite: $[Co_2CuS_4]$.

These are some of the ores which are being worked at the present time.

It has already been mentioned that down

where structural conditions were right for an impounding of supergene solutions. An example of this is the newly found orebody at Kambove. Most of the Congo deposits, however, represent concentrations of carbonates in the beds of the Mine Series down dip. The enrichment entails a loss of copper from upper portions of the beds, and a movement of these values down to an horizon which was defined by the level of the water-table in past and present times.

As pointed out by F. W. Clarke,¹ the copper carbonates may have been formed in two ways—(a) by the action of carbonated waters on copper compounds, or (b) by the

¹ Data of Geochemistry, 1924, p. 679.

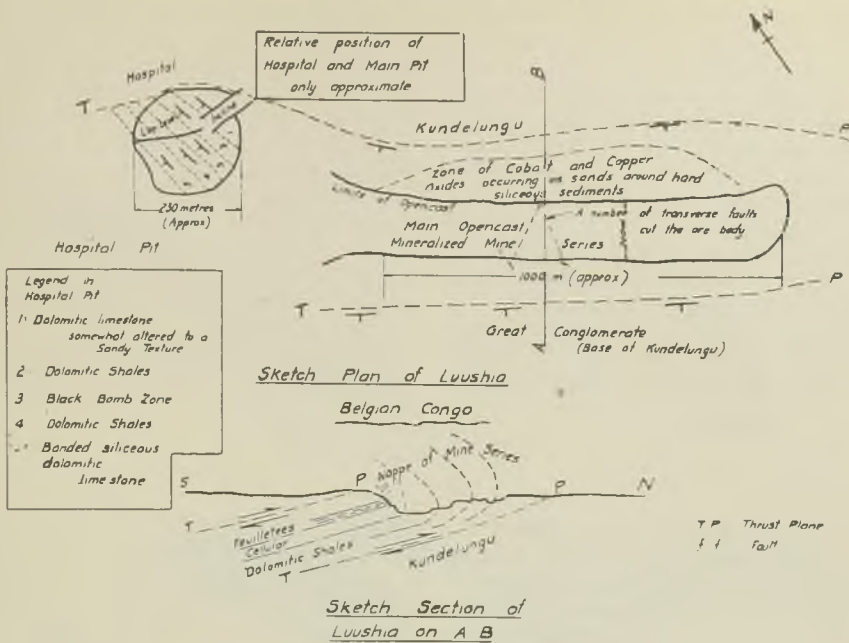


FIG. 7.

reactions of cupreous solutions and limestones. In the first case this manner of formation would be supergene, and in the second case it would be hypogene.

DISTRIBUTION AND GEOLOGY OF THE MINES.—(a) *The Star of the Congo (Etoile)*.—This mine is situated 10.6 kms. in an E.N.E. direction from the station at Elisabethville. At the present time (1929) the mine is not being worked and the open-cast is flooded, as shown in Fig. 1. It is rumoured, however, that the mine will be opened again in the near future.

The mine is in a mineralized fold of the

Mine Series where it has been pushed over the younger beds of the Kundelungu. The plan and sections shown in Fig. 2 show the general relationship and the interpretation of the structure by the writer. The beds are bent into the form of a reversed "S"; the axis of the fold is not quite parallel to the two long arms. The excavation in the southern arm was to win the mineral from the upper beds or dolomitic shales of the Mine Series. The excavation of the northern arm was to win the ore from the inferior shales below the feuilletées, or banded quartzites.



FIG. 8.—LUUSHIA, N. SIDE OF MAIN OPEN-CAST, SHOWING HARD REMNANTS OF MINE SERIES.

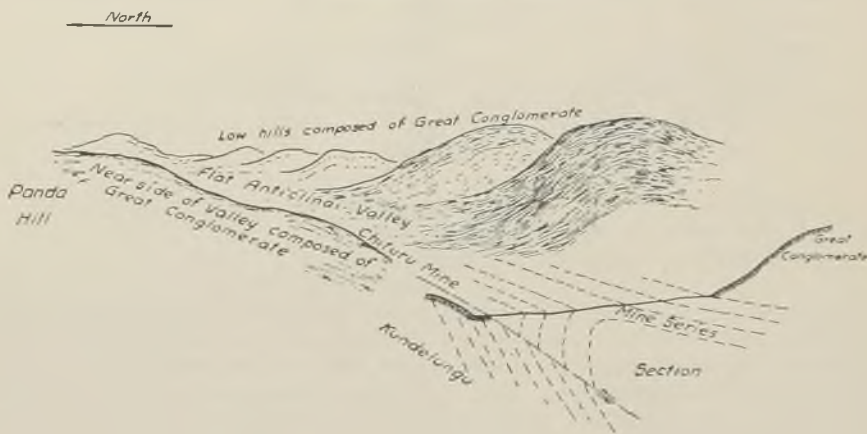
Originally the Etoile was considered to be a very rich mine, but it was shut down as a result of the general policy of the Union Minière whereby rock carrying less than 5–6% copper as carbonates is not considered a profitable ore at the present time. In the opinion of the present writer, there are still tremendous tonnages of 4–5% rock not yet removed. Estimates as to the magnitude of these amounts are futile, for the Belgian company do not discuss tonnages and tenor, nor do they give copies of their plans.

(b) *Ruashi*.—Ruashi is situated 8 kms. from the station at Elisabethville. This mine is one of the large producers at the present

Luiswishi (Kimbeyembe was not seen), and has revealed one limb of a recumbent anticline. It is highly probable that there is continuous cupreous mineralization from Luiswishi to Lukuni. The general position of the beds is the same as at Ruashi or, in general, as at Lukuni. (Fig. 5.)

(d) *Lukuni*.—This mine is 19.6 kms. to the N.N.W. from the Elisabethville station. It is a producing mine, and has only been opened for about three years. It is partly worked by underground methods and partly by open-cutting.

The general structure can be seen from the plan and section taken from M. Richet's



Sketch in perspective of Anticlinal Valley which runs East from Panda Hill.

FIG. 9.

time, and is producing both copper and cobalt. The amount being mined is not published, but the writer estimates that the output of ore is about 1,000 metric tons per day. The tenor of this ore is also an estimate, and would be placed at 10% to 15% copper. The ore is principally malachite and tenorite, with the other oxidized ores in lesser amounts.

As can be seen from the section in Fig. 3, the Mine Series are reversed at Ruashi, indicating that the ore is being mined from the lower limb of the nappe. Down dip, that is, to the south, sulphides are reported. The distance from the incline to the sulphide zone is reported as being from 80–100 metres. The workings at Ruashi are shown in Fig. 4.

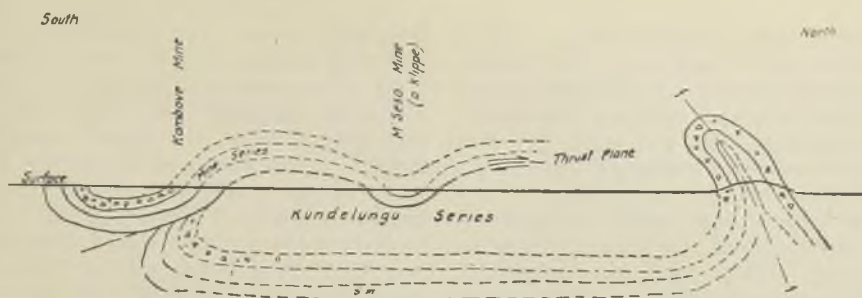
(c) *Luiswishi and Kimbeyembe*.—These are two prospects which lie north of Elisabethville and between the Lukuni Mine and Ruashi.

Trenching has been carried out on

work shown in Fig. 6. The Mine Series are overturned as at Ruashi; this overturning is seen from the fact that the feuilletées are on top of the cellular quartzites. The structure is somewhat complicated by faulting. A noticeable feature of the mines is the slumping of the beds brought about by oxidation collapse.

(e) *Luushia, or Luiswia*.—This mine lies about 37 kms. in N.W. direction from Elisabethville, and is one of the largest in the Congo. It is worked by open-cast methods. A rough sketch plan and section show the general geological relationships (Fig. 7). The ore reserves are quoted as being 5,000,000 metric tons, carrying 10% copper, but the writer believes that the potential tonnage is much greater.

The northern side of the main open-cast is being worked for cobalt. These workings are shown in Fig. 8.



Diagrammatic Section across
Kambove Anticline
after Schulling 1929
Horizontal Displacement
approximately 4 Kms

FIG. 10.

The position of the cobalt minerals (complex oxides) points to the fact that the compounds of cobalt are less soluble than those of copper. Sulphides are to be seen in the Hospital Pit, and the veinlets of chalcopyrite and kyanite in the main pit have already been mentioned.

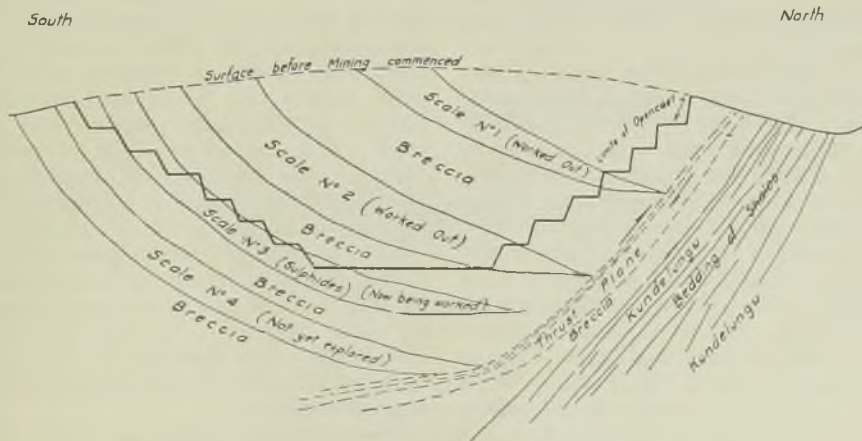
In the Hospital Pit uranium minerals are also being mined on a small scale. This fact has a great significance, because of the association of these minerals with those of copper and cobalt. In the Chinkolobwe Mine, where most of these uranium minerals are mined, it is also reported that there are small amounts of copper and cobalt. In view of this association, the Rhodesian mining authorities should keep a close scrutiny on their ores, and when in doubt ores should be tested by an electroscope.

(f) *Chituru and Likasi*.—These mines are located at Panda. The Likasi Mine is now abandoned. All the ore has not been removed and the Union Minière expect to recover what remains by letting out contracts for its removal to tributaries. The ore appears to be in a somewhat brecciated massive dolomite of the Mine Series, which has been thrust over the Kundelungu.

The Chituru Mine is now being actively worked by open-cast methods. The ore in this mine appears to be at the apex of a long anticline, which strikes east from Panda Hill.

The rough sketch in Fig. 9 shows the relationships as interpreted by the writer.

(g) *Kambove*.—This mine is situated 18 kms. in a N.W. direction from Panda, and is accessible by road or by railway. It was one of the first mines opened up in the



Diagrammatic Section of Kambove
after Schulling 1929

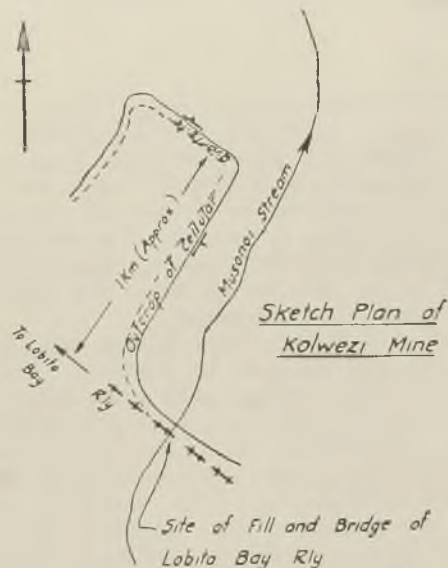
FIG. 11.

Congo, and is still a large producer. It is being worked as an opencast, but underground methods are about to be used for the extraction of some ore recently discovered by M. Schuiling. In the open pit five mechanical shovels are employed.

The following description and Figs. 10 and 11 are based on a paper which was read at the XV International Geological Congress in Pretoria, 1929, by M. Schuiling. M. Schuiling supposes that the Mine Series was thrust over the Kundelungu for a distance of about 4 kilometres. The evidence for this is the M'Sesa Mine, which is formed by mineralized rocks of the Mine Series

Schuiling is not yet published. It will probably appear in the *Comptes Rendus*.

(h) *Fungurume*.—This is a prospect which lies 60 to 70 kms. in a N.W. direction from Panda. It forms a long, fairly rugged escarpment, which strikes a little south of west, and appears to be of some length—perhaps 7 kms. From a rapid inspection the writer believes that there are two mineralized zones, perhaps scales in the sense used by Schuiling. The Mine Series appear to be in their normal sequence with the feuilletées below the cellular quartzites. The four main members of the Mine Series are mineralized. The officials of the Union



Typical Section of Mine Series

Top
 Dolomitic Shales 50 m:
 with Ore
 Cellular Quartzite 20 m
 sometimes mineralized
 Feuilletées or Banded
 Quartzites 10 m
 sometimes mineralized
 Inferior Shales 50 m:
 with Ore
Bottom

FIG. 12.

resting on a fault contact over the Kundelungu.

In the Kambove Pit three scales of the Mine Series have been recognized separated by breccia. The word "scale" is used in the sense of fish scales, one scale overlapping the other. Below the open-cast, Schuiling believes that there is a fourth scale which has only been proved by drilling.

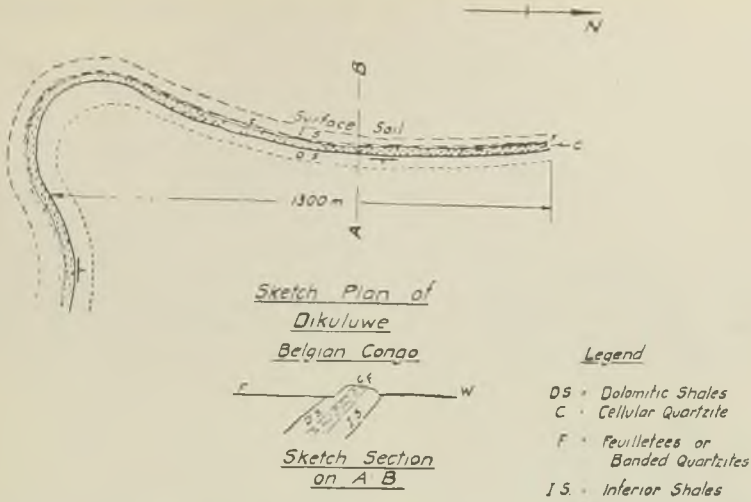
At the mouth of the open-cast a new ore-body has been found which appears to have been brought to its present position through the impounding of surface waters which have percolated through the copper-bearing rocks of the open-cast. These waters must have had copper in some form, perhaps a sulphate, and in this subsurface pool the values were precipitated as carbonates. This new mass is said to carry about 14% copper.

It is unfortunate that this paper by

Minière regard this prospect as being low grade (about 4% Cu.). There are undoubtedly enormous tonnages here, and it only awaits an economic metallurgical process to make this prospect one of real value. The ores, as seen in the trenches and outcrops, are all oxidized copper minerals. The sketch section in Fig. 5 gives the writer's impression of the general structure.

(i) *The Western Mines around Musonoi*.—This group of mines, or rather prospects, for they are not yet in the producing stage, lie about 200 kms. west of Panda. The writer was only able to visit the principal ones, which are Kolwezi, Dikuluwe, Kamoto, and Musonoi.

These western mines are all in the Mine Series and have only been scratched by the ancient or native workers. The sketches which are reproduced here must be considered as only rough attempts to show the extent



- Note 1. The Dolomitic Shales carry most of the ore but the Cellular Quartzites, the Feuilletees and Inferior Shales, are also well mineralized
- 2 This is one of the Mines of the Western Group that is being opened up

FIG. 13.

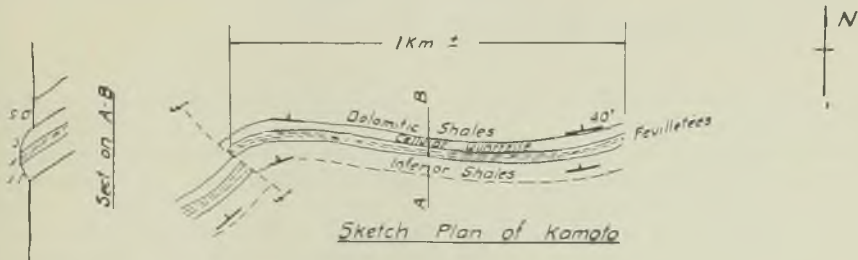
and structure. Kolwezi and Dikuluwe only are being opened up at the present time (1929). Of these mines the writer was most favourably impressed by Kolwezi and Dikuluwe. Both of these properties appear to have large tonnages, especially Dikuluwe. The estimation of 20,000,000 tons of ore from 5 to 10% copper is in the writer's mind when he recalls this mine. The other mines have possibly lesser tonnages.

The exploration of these mines is in very sound hands now that Mr. Schuiling has taken

over the geological control of the Union Minière. It is to be hoped that in the future he will be given the facilities to publish papers dealing with the geology and mineralogy of the mines operated by the Union Minière du Haut Katanga.

POTENTIAL WEALTH.—The potential wealth of the Congo in the opinion of the present writer is enormous. The reasons may be summarized as follows:

- (a) The present mines have still huge reserves.



- Note 1, Not working 1929
- 2, Dolomitic Shales and Inferior Shales mineralized cellular and Feuilletees not well
- 3, Picked Sample ran 32% Cu 18% Co but mineralization on average about 4% Cu, as Carbonates and Oxides

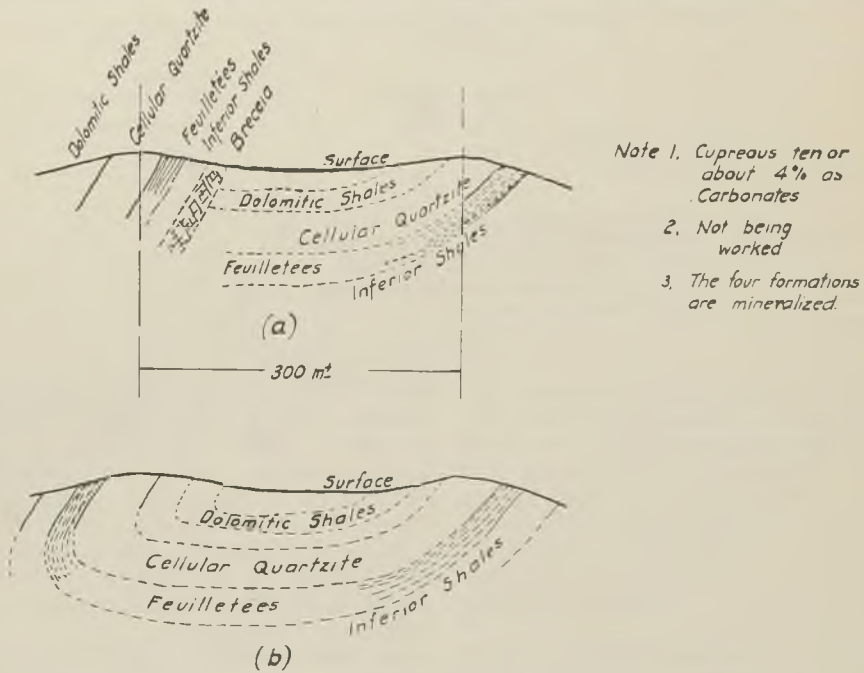
FIG. 14.

(b) There are no mines in the Congo being worked at the present time which were not known formerly to the natives and worked by them. This means that only the deposits where the outcrops were revealed are being worked.

(c) The work of the geologists of the Union Minière and of the Comité Spécial du Katanga has shown that these known mines are in the series of rocks which have been designated the Série des Mines. This series underlies the rocks of the Kundelungu formation. The Mine Series is brought to the surface by anticlinal folding and by thrust-

Series which have been disturbed by long strike faults.

(d) If the conclusion arrived at by Bancroft, Gray, and others is correct, namely, that the copper bearing rocks of Northern Rhodesia form the lower portion of the Mine Series of the Congo, then there is the possibility that mineralized beds in the Congo will be found in the future which will correspond to the Rhodesian mineralization. It should be noted here, that M. A. Timmerhaus, one of the able geologists of the Comité Spécial, considers that the Rhodesian beds are on top of the Mine Series.



Musonoi Mine - Two possible Cross Sections
 (a) is probably nearer the truth than (b)

FIG. 15.

ing. The present mines are located at various points on the exposed outcrops.

The noteworthy points are that there are long gaps in between the known mines and that there are a number of these parallel folds. Wherever these ridges are to be found they are potentially valuable as possible loci for ore-bodies. M. Le Neve, the Secretary of the Union Minière, at Panda, pointed out to the writer that the present mines are all situated at those points of the Mine Series where these rocks have been faulted. This observation does not affect the validity of the foregoing, for the map produced by the Comité Spécial shows large stretches of the Mine

Passing from copper to cobalt, it has been shown in the description of the mines, that there are rich deposits of cobalt associated with the copper ores. In "Mineral Industry for 1928" it is stated that: "Practically one half of the production of the world's requirements of cobalt are supplied from the ores of the Belgian Congo." Furthermore, the Belgian Congo controls the radium market of the world to the extent of over 90% of the annual production.

Thus it can be seen that the position of the Union Minière du Haut Katanga is strong in copper and cobalt reserves, while with regard to radium their present position is dominating.

SELECTIVE FLOTATION ON A LEAD-ZINC-GRAPHITE ORE

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

The author describes a series of tests carried out at the Eagle Lead Mines, Trefriw, in order to determine the best method for the elimination of graphite.

GENERAL NOTES.—The mines worked by the Eagle Lead Co., Ltd., are situated about two miles south-west of Llanrwst in Carnarvonshire, North Wales. The mines of this district are located on a series of lodes occurring in rocks of Bala age, mainly shales, slates, ashes and lavas. The country is traversed by a series of faults which fall into two systems, a N.-S. system and an E.-W. system, and the faults themselves are generally of the nature of crush-zones or shatter belts. Most of these faults are mineralized in the neighbourhood of the igneous rocks and the ore generally consists of fault breccia cemented by gangue and ore-minerals. The gangue-minerals are

generally quartz and calcite, while the ore-minerals are galena, blende and pyrites, and the first of these usually carries values in silver.

The lead-zinc ore on which the following tests were carried out contained a high percentage of graphite which was easily floated and which, unless prevented from doing so, or floated primary to the lead, would greatly reduce the grade of the lead concentrate.

GENERAL SCHEME OF TREATMENT.—The ore was first crushed to - 2 in. and fed by hand into two Parker granulators, set to crush to - ½ in. The crushed ore was then elevated to a bin above an Allis Chalmers feed table

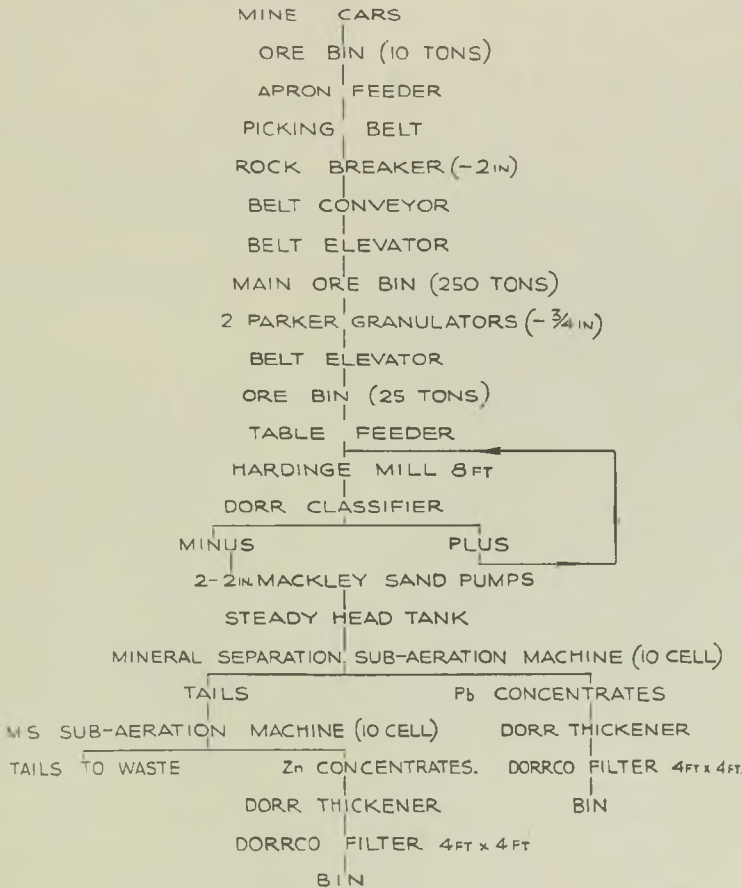


FIG. 1.

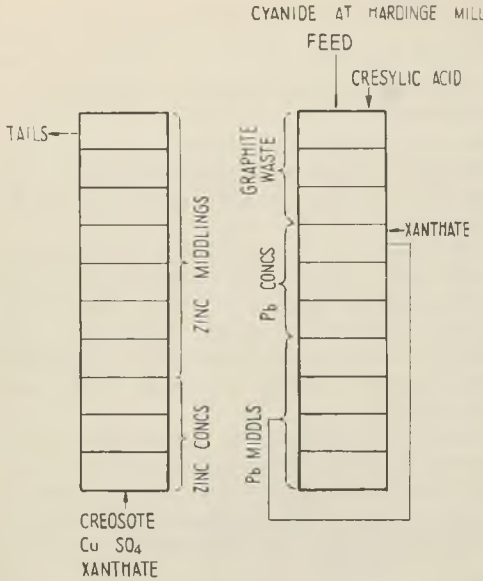


FIG. 2.

which automatically fed an 8 ft. Hardinge ball-mill in closed circuit with a Dorr classifier. The undersize from the classifier was pumped by two 2 in. Macklay sand pumps into a head tank to regulate a steady flow to the Mineral Separation 10-Cell Sub-Aeration flotation machine. The middlings from both lead and zinc machines were pumped back to the head of their respective machines by two Tange centrifugal pumps. The concentrate flowed direct into Dorr thickeners to be filtered by two 4 ft. by 4 ft. Dorrco filters. It was found possible to get a sufficiently regular feed to the M.S. machines without the use of the head tank, but better conditions would have been obtained if the feed had been sent to a thickener before being fed into the M.S. machine, as it was found that the dilution of the pulp was one of the main reasons for keeping the graphite from floating. A generalized flow-sheet is shown in Fig. 1.

TEST No. 1.—Starch was added at the Hardinge mill to depress the graphite. It was added as a 1% emulsion, having been mixed and boiled as for laundry purposes and was added in various amounts ranging from ½ lb. to 4 lb. per ton of ore. This did not wholly depress the graphite and partially depressed both the lead and zinc, even when added in the smallest quantities. The grinding was carried out to - 80 mesh, and the dilution of the pulp was 3 to 1 in the lead machine.

The reagents used are tabulated below :—

	lb./ton of Ore.
Starch to Hardinge Mill	½ to 4
Cyanide to Hardinge Mill	0.25
Cresylic Acid to 1st Lead Cell	1 to 1.5
Xanthate to 1st Lead Cell	0.25
Creosote to 1st Zinc Cell	0.25
CuSO ₄ to 1st Zinc Cell	2.0
Xanthate to 1st Zinc Cell	0.5

The following results were obtained from this test. The feed assayed 4.89% zinc and 5.20% lead. The lead concentrates contained 33.26% lead and 2.59% zinc, while the zinc concentrates ran 30.96% and 1.10% lead and the tailings contained 2.10% zinc and 1.00% lead.

TEST No. 2.—In this test the use of starch was discontinued and the graphite was floated off the first three cells of the lead machine by means of cresylic acid, xanthate being added to the 4th cell to raise the lead (see Fig. 2). These three cells were not sufficient to float all the graphite, but the results, given below, showed considerable improvements.

As in Test No. 1, the grinding was done to -80 mesh and the dilution of the pulp was 3 to 1 in the lead machine.

The following table shows the quantity of reagents used :—

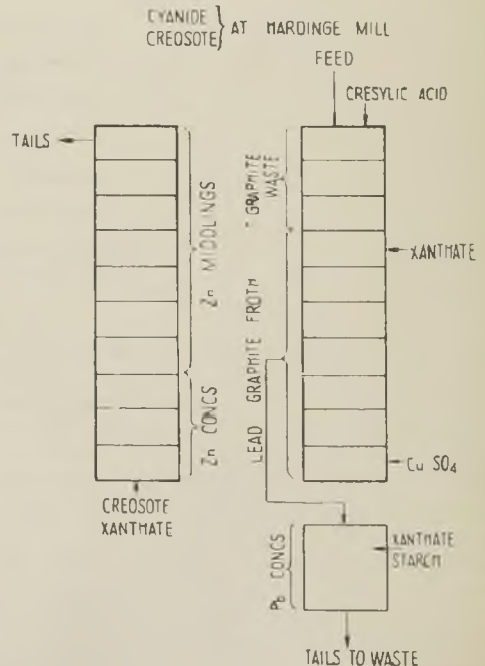


FIG. 3.

	lb./ton of Ore.
Cyanide to Hardinge Mill	0.25
Cresylic Acid to 1st Cell of Lead Machine	1-1.5
Xanthate to 4th Cell of Lead Machine	0.25
Creosote to 1st Cell of Zinc Machine	0.25
CuSO ₄ to 1st Cell of Zinc Machine	2.0
Xanthate to 1st Cell of Zinc Machine	0.5

The following results were obtained. The feed in this case assayed 4.54% zinc and 4.23% lead. The lead concentrates carried 42.15% lead and 1.49% zinc, the zinc concentrates 43.50% zinc and 0.33% lead, the graphite waste 5.40% lead and 1.99% zinc, while the tails ran 1.00% zinc and 0.76% lead.

TEST NO. 3.—This test differed but slightly from the last, creosote being added at the Hardinge mill to float more graphite in the first 3 cells. In addition, the lead-graphite froth from cells 4 to 10 was sent to a single cell cleaner machine where both starch and xanthate were added (Fig. 3). A better lead-concentrate was obtained, but too much lead was lost in the tailings of the cleaner machine, which could not be returned to the main circuit owing to the presence of starch. Copper sulphate was added at the tail end of the lead machine and before the xanthate, with beneficial results.

As in the previous tests, grinding was to - 80 mesh and the dilution of pulp in the lead machine was 3 to 1.

The reagents added are shown in the following tabulation:—

	lb./ton of Ore.
Cyanide to Hardinge Mill	0.25
Creosote to Hardinge Mill	1-1.5
Cresylic Acid to 1st Cell of Lead Machine	0.5
Xanthate to 4th Cell of Lead Machine	0.25
Creosote to 1st Cell of Zinc Machine	0.25
CuSO ₄ to overflow from Pb Machine	2.0
Xanthate to 1st Cell of Zinc Machine	0.5
Starch to Single Cell	0.5-4
Xanthate to Single Cell	0.4

The results obtained from this test are shown in Table 1.

TEST NO. 4.—In this final test the addition of creosote at the Hardinge mill was discontinued, and the grinding altered to - 60 mesh instead of - 80 mesh as in the preceding

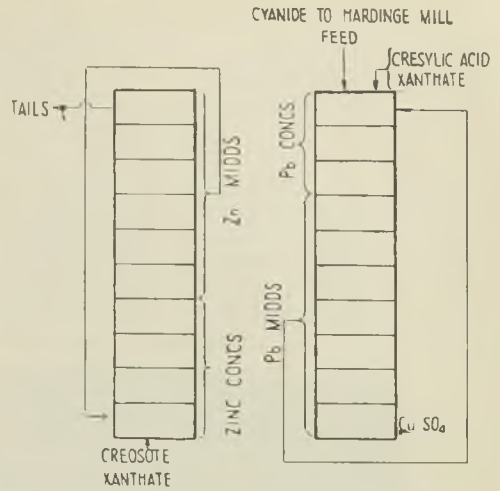


FIG. 4.

tests. This altered the dilution of the pulp in the lead machine to a little under 2 water to 1 of ore. Cresylic acid was added to the 1st cell of the lead machine in such quantities as only gave very little froth. Xanthate was also added to the first lead machine, approx. 0.75 lb./ton. This brought up the lead with hardly a trace of graphite. The air from the blower was cut off entirely as this tended to break up the froth and also to float some graphite. It was noticed that whenever the dilution of the pulp was thinner than 2-1 the graphite started to float with a little zinc also. The cresylic acid had to be kept constant as with 2 ccs. per minute in excess of the desired amount the froth would become black with graphite and if 2 ccs. less than the desired amount were added no froth at all was obtained. At times the amount of xanthate added was as high as 1.5 lb./ton of ore to the lead machine alone. It would have been possible to have obtained a lead concentrate of over 70% with a feed of under 1% lead if the frothing area of the cells had been baffled. In the tailings launder the graphite could be seen leaving the mill floating on the surface of the water as a fine oily slime (Fig. 4).

TABLE 1.

Heads.		Zn Concs.		Pb Concs.		Single Cell Tails.		Graphite.		Tails.	
Zn	Pb	Zn	Pb	Zn	Pb	Zn	Pb	Zn	Pb	Zn	Pb
%.	%.	%.	%.	%.	%.	%.	%.	%.	%.	%.	%.
11.00	0.72	48.72	0.72	1.44	72.84	2.20	1.80	2.83	0.81	2.64	0.26
4.42	0.38	50.97	0.10	1.10	78.11	1.63	4.71	3.55	3.17	0.53	0.07
4.51	2.17	49.10	0.31	1.05	59.00	1.53	3.33	1.05	0.48	0.38	0.13

The reagents added are as follows:—

	lb./ton.
Cyanide to Hardinge Mill	0.25-0.4
Cresylic Acid to 1st Lead Cell	0.5-0.7
Xanthate to 1st Lead Cell	0.75-1.5
CuSO ₄ to overflow from Lead Machine	2.0

	lb./ton.
Cresosote to 1st Zn Machine	0.5
Xanthate to 1st Zn Machine	0.5

The results from Test No. 4 are shown in Table 2.

TABLE 2.

Heads.		Zn Concs.		Pb Concs.		Tails.	
Zn %.	Pb %.	Zn %.	Pb %.	Zn %.	Pb %.	Zn %.	Pb %.
8.73	2.42	49.71	0.27	2.62	65.94	1.94	0.09
13.73	5.56	52.72	1.06	2.52	67.89	1.01	0.13
11.50	5.95	50.29	2.56	2.02	75.31	1.91	0.22
13.02	5.48	52.72	0.26	2.02	74.25	2.02	0.13
12.92	1.00	52.52	0.26	2.22	69.83	1.21	0.13

THE EARTH-RESISTIVITY METHOD OF ELECTRICAL PROSPECTING

By E. LANCASTER-JONES, B.A.

Electrical and telegraph engineers have long been familiar with the fact that the earth acts as a conductor for electric currents, and have recognized the importance of the nature of the soil in which a ground contact was made. Their attention, however, was focussed upon the effective resistivity in the immediate neighbourhood of the grounded electrode, for it was recognized that almost all the resistance was localized in a restricted area near the contact. At the same time, attempts were made by early experimenters in electrical prospecting to measure the variations of resistivity in the region between two electrodes, when a current introduced into the ground at one electrode was withdrawn from the ground at the other. Since different strata, ores, etc., usually have characteristic electrical resistivities, the importance of such measurements was evident. The basis of the measurement is the well-known law

$$\text{Resistance} = \frac{\text{Voltage}}{\text{Current}}$$

and, although both voltage drop and current are usually small in earth-circuits, there appeared to be no difficulty in measuring these quantities, and deducing the resistance as the ratio of the two. The early attempts, however, failed, either because the effect of polarization currents, created by electrolytic action at the electrodes, were insufficiently appreciated, or because the apparatus for utilizing alternating current (whereby polarization is avoided) was not sufficiently developed.

In 1925 O. H. Gish and W. S. Rooney, using apparatus evolved in the course of the

experimental work on terrestrial electricity carried out by the Carnegie Institute, of Washington, made important investigations into the relation between the distance apart by which the measuring electrodes were separated and the depth of ground apparently explored at each distance. They showed that, with a standard arrangement of electrodes, the electrode separation was proportional to the depth of penetration; so that, if at a certain depth an abrupt change in electrical characteristics of the ground took place (e.g. a transition from a region of high conductivity to one of low conductivity, or vice versa) this became markedly noticeable when the electrode-spacing was approximately equal to the depth of the transition surface. The apparatus and method are described in *Terrestrial Magnetism and Atmospheric Electricity*, vol. xxx, No. 4, Dec., 1925. Four contacts, or ground-electrodes, are spaced at an equal distance apart along an approximately straight line. The current, I, introduced at one extreme and taken out at the other extreme electrode is measured, and the potential difference V between the two middle electrodes is also measured. Since all the current must pass between the potential surfaces which terminate (at the ground surface) at the two inner electrodes, the total resistance of the earth between these potential surfaces is given by the ratio $\frac{V}{I}$. This total resistance is made up of the resistances of portions of the ground between the inner electrodes from the surface down to an unknown depth. If the specific resistivity of the ground, to a

lateral extent and depth very much exceeding the electrode spacing, is a constant value ρ , it could be established quite rigidly that

$$\rho = 2\pi a \frac{V}{I}$$

where a is the distance between each neighbouring pair of electrodes.

When, however, the resistivity varied with depth below surface, it was assumed that the quantity ρ given by the above formula represented the so-called "average" resistivity to a lateral extent and vertical depth equal to the electrode interval a . By increasing this interval a , greater depths

established the value of the method for determining lateral and vertical variations in the nature of the ground, not merely qualitatively but also, to a surprising degree of accuracy, quantitatively. For example, the sections, in two perpendicular directions, of a filled-in ravine were deduced from resistivity measurements at increasing electrode spacings at several points along each section line. The deduced section corresponded very closely to the sections derived from constructional data. Also, equally satisfactory deductions were made in other areas regarding the variations in depth

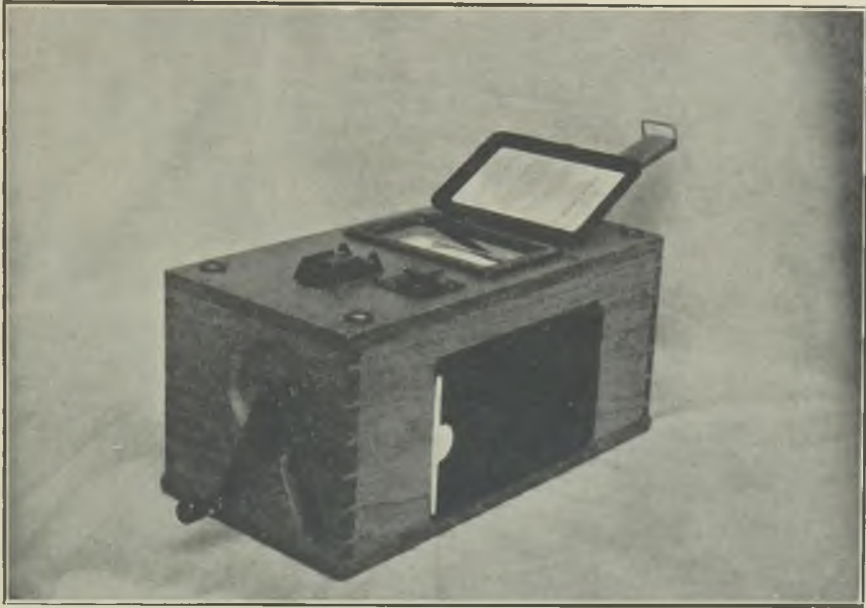


FIG. 1.—THE MEGGER EARTH-TESTER.

could be explored and from a series of measurements a knowledge of changes of resistivity with depth could be obtained at any desired number of points throughout the region surveyed.

It is not clear, however, exactly what was meant by the expression "average" resistivity. Apparently the effect of the ground in the immediate vicinity of the line joining the electrodes preponderated, so that the average was what is known as a "weighted" one, not further specified. This ambiguity in the definition of the nature of the "average" measured in earth-resistivity surveys has persisted in the accounts of similar work, and will be given more detailed consideration in the present article at a later stage. The general results of the Gish-Rooney tests, however, quite definitely

of the water horizon, and the bedrock surface. In some cases the depth of penetration exceeded 1,000 ft. These experiments evidently revealed a novel method of geophysical surveying, which subsequent tests have confirmed. The apparatus used has been slightly modified but the field procedure is substantially unchanged. A modification of the normal field procedure will, however, be outlined in this article.

FIELD PROCEDURE.—Over the whole area to be surveyed, a series of traverse lines is marked out, preferably parallel to two perpendicular directions selected with reference to the general strike-lines in the neighbourhood, if these are known. Failing this knowledge, the lines may be laid out in the magnetic NS. and corresponding EW. respectively. The distance between the

parallel traverse lines is most suitably roughly equal to the anticipated depth of any surface of separation to be explored. Along each line a series of resistivity determinations is made, at gradually increasing depths of penetration (i.e. electrode-spacing). For the smaller depths, the stations at which measurements are made can conveniently be separated by the same interval at the spacing of the electrodes. For greater spacings, the station separation should not be unduly extended.

Each determination of resistivity at a station involves laying out the four electrodes at the selected equal spacing interval along the line of traverse with the

the value ρ is obtained for each electrode spacing interval a . The values ρ are then tabulated, in correlation with the positions of the stations and the electrode spacing intervals.

APPARATUS.—The apparatus required for earth-resistivity measurements comprises: The Current Generator, with commutating arrangements; the Measuring Instruments; Conducting Leads; Electrodes; Surveying Equipment—tape, theodolite, etc. As generator, Messrs. Gish & Rooney employed large capacity dry batteries, giving a total voltage of 135 volts, with intermediate tappings. A special commutator was introduced between the meters and the electrodes.



FIG. 2.—FIELD APPARATUS IN USE.

station at the centre, connecting up the extreme electrodes to the current supply system, and the inner electrodes to the potential measuring system. The current supply may consist of a battery or a direct-current dynamo, the current of which passes first through the coil of a meter and next through a commutator which transforms it into pulsating or alternating current before it reaches the terminals connected to the outer electrodes. It is picked up by the inner electrodes as an alternating potential, commutated and then passed through a potential-measuring device. Thus the quantities V and I are measured, and from the equation

$$\rho = 2\pi a \frac{V}{I}$$

The meters consisted of a Leeds and Northrup potentiometer, for the voltage measurements, and a Weston milliammeter; each instrument had various ranges to suit measurements at small and large electrode spacings.

In later measurements, all the above set of apparatus has been replaced by a single, compact unit known as a Megger Earth Tester (Fig. 1), which had been previously developed for measuring such resistances, e.g. as those of ground plate contacts, and which was very readily adapted to measure earth resistivities. This instrument is described in detail at a later stage.

The conducting leads are of the type normally used for field signalling, consisting of stranded wire, which may be copper or steel or a mixture of both, well insulated

against casual ground contacts. The resistance of the leads is not an important consideration, as it is normally well below that of the electrode-ground contacts.

As electrodes, stout metal pipes of the type frequently employed as earths in domestic wireless may be very suitably employed. They should, however, be of galvanized iron rather than such soft metals as copper or aluminium, in order that they may withstand the constant insertion into and withdrawal from the earth. Suitable electrodes are normally provided with the Megger, but the number should be adequate to avoid waste of time in setting up. The best type of contact making device is a plug and socket arrangement. Terminal screws and spade terminals are not so suitable. (Fig. 2.)

CONSIDERATION OF RESULTS.—The customary practice is to plot, for each section line, the curves representing the variation in the "average" resistivity ρ along the section, for each separate electrode spacing interval, there being one curve per interval. These curves are then studied in relation to one another and to any known facts regarding the region, and interpreted in terms of construction, extent, depth, configuration, etc., of the successive strata. It is generally found that the measurements along a traverse at a small electrode spacing show much more irregularity than those at larger spacings. This is due to the rapid variation of the nature of the normal overburden, consisting of sands, clays, gravels, etc., with varying degrees of water content, which overlies the rock. The latter usually preserves a much greater degree of homogeneity of structure.

Normally the average resistivity at any one point tends to increase with depth, but there may be a reversal corresponding to the introduction of more conducting material, at a depth corresponding to the water horizon. From this stage, the tendency to increase in resistance may persist, until subsequent reversals indicate the penetration of more conducting strata. Similarly, a study of the variation of any one curve along the traverse will indicate the variation in depth of any particular feature, provided, of course, that feature does not lie at a depth exceeding the corresponding electrode spacing. Evidently the curve corresponding to a shallow depth—i.e. small electrode spacing—cannot be expected to cast much light on the conditions at depths much below its penetration. Nevertheless, as will be shown later, the indications are not so limited as have been

previously represented, and, in actual fact, the curve corresponding to a spacing interval a is affected by conditions down to a depth of at any rate double this amount.

The indications arrived at on the basis that "electrode spacing equals depth of penetration" should therefore only be taken as an approximate guide, and more detailed interpretation should be based on a correct theory of the distribution of earth currents and potentials in a non-homogeneous medium coupled with a careful analysis of all the data available in the series of curves representing different electrode intervals. The tests subsequently to be described show that greater reliance can normally be placed on measurements made at fairly large electrode spacings, where the effects of local irregularities in the overburden are to a great extent smoothed out.

APPLICATION TO PROSPECTING FOR ORE.—Since many valuable ores are good conductors of electricity, and since other electrical prospecting methods have proved successful in locating such ores, it is natural to conclude that the earth-resistivity method is equally applicable to this project. With the view of confirming this, tests have been made, notably by the following:—W. O. Hotchkiss, W. J. Rooney, and J. Fisher over the Copper deposits of the Lake Superior district (see "Geophysical Prospecting, 1929," A.I.M.E., p. 51) and F. W. Lee over Magnetite deposits (see U.S. Bureau of Mines, Tech. Paper No. 440, 1928). These tests have proved successful. There is also every reason to believe that tests over salt deposits, or domes, which are very bad conductors, would prove successful.

(To be continued.)

BOOK REVIEWS

Geologische Karte der Erde. Lieferung 1. Blätter 1-4. Scale $\frac{1}{15,000,000}$. Subscription price 150 marks. Berlin: Gebrüder Borntraeger.

There has hitherto been no satisfactory geological map of the world, obviously, of course, for lack of sufficient data. The present attempt undoubtedly promises to be a great advance on previous efforts, and although certain regions must still, perforce, remain blank, and others will necessarily appear to be better known than is actually the case, there are so many purposes for which a world map is desirable that the enterprise is one for which geologists will

everywhere be grateful. The complete map will consist of twelve sheets, each about 2 feet by 2 feet 6 inches. It is being prepared by Professor F. Beyschlag under the editorship of Dr. W. Schriell for publication by the Prussian Geological Survey. The part now issued consists of the four northern sheets, embracing Europe, Asia as far south as Japan and the Caspian, Canada and the northern part of the United States. The next four sheets will cover the tropical lands, while the third set will complete the map with Antarctica New Zealand, the balance of South America, the tip of South Africa and the south eastern half of Australia.

It will be difficult to judge the map until the whole has appeared, for at present there is no colour index. A preliminary list of formations and symbols is included, but in many places the patches of colour are too small to carry a symbol, so that, until the coloured legend promised with the third delivery becomes available, the map cannot be read without a great deal of trouble. Although the scale is small, 1 : 15,000,000, the colouring is so clear and transparent and the registration so excellent, that more detail is shown than one might think practicable. The system of classification may be illustrated by the treatment of the Palaeozoic, with the symbols adopted :—

Pl = PALÆOZOIC.	
p = Permian	$\left\{ \begin{array}{l} p_2 = \text{Upper Permian.} \\ p_1 = \text{Lower Permian.} \end{array} \right.$
ph Permian and Carboniferous.	
h = Carboniferous	$\left\{ \begin{array}{l} h_2 = \text{Upper Carboniferous.} \\ h_1 = \text{Lower Carboniferous.} \end{array} \right.$
d = Devonian	$\left\{ \begin{array}{l} d_2 = \text{Upper and Middle} \\ \text{Devonian.} \\ d_1 = \text{Lower Devonian.} \end{array} \right.$
s = Silurian	$\left\{ \begin{array}{l} s_2 = \text{Upper Silurian (Ordo-} \\ \text{vician).} \\ s_1 = \text{Lower Silurian} \end{array} \right.$ (Silurian).
scb = Ordovician, Silurian and Cambrian.	
cb = Cambrian.	

It is unfortunate that the old-fashioned significance of "Silurian" is retained. The ocean floor is represented by contours and layer colouring in pale tints of blue. Rivers, coast lines, lake-shores, and place names (which are not crowded) are printed in glossy black. The whole effect is clear, attractive, and well-proportioned. We shall look forward with interest to seeing the remaining sheets, which cover most of the less familiar regions of the earth, and hope to have an opportunity of referring again to the map when it is completed.

Theorie der Erdbebenwellen ; Beobachtungen ; Bodenunruhe. By B. GUTENBERG. Handbuch der Geophysik, Vol. IV, Part I. Paper covers, 298 pp., illustrated. Berlin: Gebrüder Borntraeger.

This handbook is a characteristically thorough treatise of geophysics which is to be completed in ten volumes, number IV of which is devoted to earthquakes, and Part I of this volume, which is now under review, includes "earthquake-waves, observations, and ground unrest." In this part Professor Gutenberg gives an excellent mathematical account of the propagation of disturbances, and this is followed by a study of the paths of seismic waves in the interior of the earth. The theory of surface waves is also dealt with and the development of this subject is followed historically through the work of Rayleigh, Love, Uller, Jeffreys, and Jeans, concluding with a modern development of the fundamental ideas on the subject.

The second portion of the book deals with observations on seismic waves and the indications given by distant earthquakes, while consideration is also given to the observation of waves from nearby sources of disturbance and to surface waves.

This book, although intended primarily for the pure geophysicist, will be of considerable interest to those engaged in the application of the seismic method to geological problems and who possess the necessary mathematical knowledge. The last portion in particular will prove of value to the applied geophysicist who will find in this chapter information on ground unrest which is both of interest and utility. The various types of ground unrest due to industry, traffic, waterfalls, volcanic sources, storms and atmospheric pressure changes, wind, surf, and freezing are all considered in detail, and particulars are furnished in certain cases of the characteristic frequencies and amplitudes of these various sources of disturbance. The absence of an index forms the one outstanding deficiency, and although it may be proposed to furnish one for the complete volume, a separate index for each part is indispensable in such a comprehensive work.

H. SHAW.

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

LETTERS TO THE EDITOR

The Education of the Engineer

SIR,—The outspoken critical letter from Mr. John A. Agnew in your May issue, coming as it does from a man of distinction and experience, seems to me to call for an answer. He is of opinion that although the students of the Royal School of Mines receive "a splendid education" the atmosphere in which the education is received is disadvantageous, its effect being to turn out men with the idea that "being of British nationality they start off in competing for important positions with a very big advantage over men of other nationality." This is the first time for many years that I have heard this country accused of having a superiority complex. From that point of view I find the accusation highly refreshing; even if it were true, I should not accept it as a grave charge.

Mr. Agnew remarks that young American mining engineers know that they must look forward to a period after their university career in which they have "to get down to real hard work in order to demonstrate their fitness to fill a position of even moderate importance." On the other hand he is of opinion that the post-graduates of the Royal School of Mines have "the expectation of being put into something good within a very short period of their leaving the School." Now I am not in a position to state whether the belief of the young American engineer is founded on experience or not, but I do happen to know that the expectation of the post-graduate at the Royal School of Mines, deplorable though it may be to Mr. Agnew, is founded upon experience. The large majority of post-graduates from the Royal School of Mines are in fact "put into something good within a very short period of their leaving the School." I think we may take this as a great tribute both to the quality of the men and to their "splendid education." In the absence of Professor Truscott, who has been away in South Africa, I forbear from quoting statistics; if they would interest your readers he will no doubt be able to supply them when he returns.

At the end of his letter Mr. Agnew abandons vague generalities and makes a definite statement—namely, that he recently sought diligently for men of British nationality for two highly important and responsible positions, without success, and had to take Americans. He takes this to strengthen his

belief that there is something radically wrong with the training of British mining engineers. I accept his statement, but I think he has drawn the wrong conclusion. The right conclusion, so far as I can judge, is that for some reason or other the number of English men coming forward for a full scientific training as mining engineers is small, whereas the total number of Americans is far larger; the field of choice is therefore far more restricted in the British Empire. If there are 10 American university-trained mining engineers available for every one British, we must expect to find some of them occupying important positions in the British Empire, particularly in enterprises assisted by American capital. If this correspondence succeeds in making more widely known in this country the many important posts in the mining world open to men of good physique, character, and education, some good will have been done.

Finally, though Mr. Agnew has no desire to "belittle the work of the Royal School of Mines," I cannot but feel that the tone of his letter is to be deprecated as tending to give many of your readers a wholly false impression of the character and ability of the graduates of the Royal School of Mines. If he had been good enough to pay Professor Truscott or myself the honour of a visit, we might have benefited by his experience and he might have modified his views before giving them such wide publicity.

Yours faithfully,
H. T. TIZARD,
Rector.

Imperial College of Science and Technology,
London, S.W. 7.
May 22.

SIR,—As an Associate of the Royal School of Mines, I have read with deep interest the articles in the April and May issues of your MAGAZINE, and Mr. John Agnew's letter to you of April 29. Whilst I have the greatest respect and admiration for the Royal School of Mines and its traditions, I feel that Mr. Agnew's criticisms are largely justified, and it is only by the realization of this fact by its students and Associates that the defects which he mentions can be remedied. It should be more generally realized by graduates just leaving the school that, while well fitted, as a result of the technical knowledge which they have acquired, to grapple with many of the problems which ultimately they will meet in their career, they are still

only on the threshold of that practical experience which is essential before they can hope to attain to responsible positions in the profession. Also, speaking generally, English mining engineers are less adaptable than those of several other countries, particularly those of the U.S.A., and every effort should be made to overcome this defect.

It is not, as Mr. Agnew suggests, that young English college graduates imagine they start with a big advantage over others because of their nationality, but because they feel their technical training should give them that advantage, as they do not sufficiently appreciate that before it can do so it must be supplemented with the very necessary practical underground experience. Certainly more grit is required to make a good technically-trained and practical mining engineer than is necessary in most professions, and it is particularly during the period when the practical underground experience is being obtained that this quality is needed in large measure.

An Associate of the Royal School of Mines, or other English college graduate, who accepts a post as a junior sampler on a big mine as his first job is too apt to regard the billet as a necessary evil to be endured for as short a time as possible. Consequently, he often puts little or no enthusiasm into his work and at the first opportunity he usually gets transferred to the survey department. Here, as he has to spend relatively little time underground and as his technical knowledge is called into play, he feels he has more of a "gentleman's" job. Therefore, he clings to it, hoping from it to eventually become an assistant manager or a manager.

Largely due to his very excellent technical training he gets the false idea that his knowledge is being wasted while he is working underground as a sampler and that he is degenerating into a manual labourer. Did he but appreciate it, some of his best training, and his likelihood of quicker promotion, lies in his taking a keen interest in his sampling work. This work is of the utmost importance, as the manager has to rely on the correctness of the sampling results in arranging the underground work so that he can maintain the correct average monthly grade of the ore milled.

Even if a junior sampler rarely sees the manager, provided he does his work conscientiously and well he may be quite sure that this latter fact is well known and is also appreciated by the manager. Later, a few

months in the survey office will be of great use to him, but he will generally be wiser not to remain there very long and to go underground again, aiming at ultimate promotion to assistant manager or manager through the jobs of shift-boss, mine captain, and underground manager. Although the time I spent in the survey department of a big mine was of great use to me, that which I spent sampling and shift-bossing underground proved of far greater use and of the utmost value to me in later years when I was managing mines.

One of the greatest assets for a successful mine manager lies in his ability to handle various types of men and readily to obtain willing service from them. This has to be acquired by the mining engineer over and above his technical knowledge—and before he can hope to obtain a position of great responsibility—and the time devoted to underground work will be spent in one of the best training grounds in which to do this.

C. BARING HORWOOD.

Abbey House, Victoria St.,
S.W. 1

May 28.

Magnesite Deposits in Serbia

SIR,—Mr. A. Ignatieff, in his article in your April issue, attributes the formation of the more important deposits to hydrothermal solutions and, by implication, labels them as hypogenetic; he might, advantageously, have stated that there is a sound physical-chemical basis in experimental work for the conclusions he arrived at, which should be more generally known and appreciated than it appears to be.

One of the features in common possessed by magnesite deposits of the pure magnesium-carbonate-Euboean type, to which those described by Mr. Ignatieff would appear to belong, is their quite usual occurrence in highly serpentized basic rocks, the alteration to serpentine being so extensive and thorough as to give the impression that the original rock has been *searched* by some reagent that has altered it. That the reagent was chiefly CO₂ in the presence of water or water vapour, is at once suggested by extensive carbonatization and formation of hydrous minerals, as serpentine and (or) talc.

Now, the experimental work of Haehnel¹

¹ O. Haehnel, *Journ. f. prakt. Chemie*, 107, 1924, pp. 165-176; also *op. cit.* 108, 1924, pp. 61-74.

H. C. Boydell, *Trans. Inst. Min. & Met.*, 1927-8, p. 59, 176.

lends experimental support to the view that formation of magnesite, in a geological setting with a serpentine bed-fellow, is due to attack on basic magnesium rocks by hydrothermal solutions containing CO_2 , and that thoroughness of serpentinization, so commonly observed under these conditions, is due to the mobility and pressure of the active re-agent CO_2 . This work is important geologically because it forms sound ground for belief in the probable occurrence of a large number of reactions fundamentally important with regard to the solution, formation, or decomposition of dolomite and magnesite. In my opinion, his experimental work provides such a sound cause for the hypogenetic origin of magnesite that, unless there is strong evidence to the contrary, it is only reasonable to assume such origin for most important deposits of the mineral and thus remove the formerly existent and very general impression that magnesite deposits were essentially super-genetic in origin.

The considerations mentioned in the foregoing find as much application in connexion with replacement as they do in simple vein filling; Mr. Ignatieff makes no mention of replacement when describing the Serbian magnesite deposits. Are we to understand that it is not observable in them? If this really be so, I am the more surprised, because, in my examination of the Euboean deposits in 1921, replacement was almost ubiquitous and could be recognized in all stages, from slightly replaced rock to the completely replaced one showing no traces of the palasome. In connexion with Mr. Ignatieff's statement (p. 219) that "As a general rule it has been found that the pockets and veins of magnesite do not continue in depth . . .," I suggest that ultimately it may be found the deposits are as intermittent and essentially lenticular in depth as they would appear to be, from his description, in strike. Another possibility is that the deposits may have a pitch, due to the depositing solutions having followed an inclined (not vertical) direction during ascent. It is also possible that the main deposit may not yet have been located, those discovered up to the time of Mr. Ignatieff's description being offsets or droppers from the main one which, when identified, may be found to have more continuity in depth.

H. C. BOYDELL.

Toronto, Ontario.
May 7.

NEWS LETTERS

JOHANNESBURG

May 8.

Gold Output Still Increasing.—Figures given in recently published reports of our gold-producing companies and the latest statistics issued by the Transvaal Chamber of Mines indicate not only that the industry is in a very sound and satisfactory position, but that the zenith of prosperity has not even yet been reached. The Chamber's figures show that the Transvaal gold output for the first quarter of the current year was 2,590,359 oz., representing an increase of 32,094 oz. on the yield for the corresponding period of 1929. The tonnage crushed is 90,880 tons in excess of that treated in the first three months of last year, and there is an improvement of £96,073 in the profit. The revenue per ton is the same for both quarters—28s. 3d.—while working costs at 19s. 10d. show a saving of 2d. per ton, with the result that the working profit per ton is 8s. 5d. as against 8s. 3d. The Witwatersrand's milling results for the first quarter of 1930 show the following increases: Tons milled, 77,500; yield, 33,688 oz.; profit, £10,475. There is a gain of a penny per ton in working revenue, and a reduction of twopence per ton in working costs.

A Race to the Reef.—An interesting race to the reef is proceeding between two of the developing mines of the Far East Rand—East Geduld and Daggafontein, which are sinking shafts. Whatever be the result as far as sinking is concerned, it seems certain that the first bar of gold will come from East Geduld. This company has already commenced to erect its reduction plant, which will be of the most modern type, and will cost about half a million sterling.

World's Deepest Mine.—The average depth of stoping levels for the past year in the Village Deep mine, which has been purchased by the owners of the adjoining property, the Robinson Deep, Ltd., was 6,535 ft., vertically below the collar of No. 3 shaft, and for the month of December was 6,615 ft.; the 41st level is sited at a vertical depth of 7,529 ft., and the west sub-incline shaft attains a depth of 7,638 ft. To carry on efficient and profitable mining operations at such depths, at a cost for the year of no more than 20s. 9d. per ton milled, is an outstanding achievement, and one which redounds greatly to the credit of the technical

advisers, the management, and the staff who have accomplished it. The Village Deep is one of the most interesting of the Rand's 32 producing gold mines, and there is a general feeling of regret that it has ceased to operate as a separate unit.

Transvaal Copper.—There is only one producing copper property in the Transvaal, and it is situated at Messina, near the Rhodesian border. The owners of this property are engaged on a large programme of extension of their two existing mines, and have opened up a new mine where the prospects are favourable. This work is in hand at present, but in view of the recent fall of approximately 25% in the price of copper, the company's already authorized programme will have to be reconsidered and possibly modified.

A Rhodesian Iron Ore Deposit.—In his annual report, the Director of Geological Survey of Southern Rhodesia, after describing the geological features of the Que Que Gold Belt, says that south-westwards of these rocks and dipping steeply beneath them, is a belt, $1\frac{1}{2}$ miles wide, composed of basaltic greenstone with interbedded banded ironstone and quartzite. Beyond this again is a triangular stretch of country formed of volcanic rocks of a more acid nature, associated with agglomerates and greywackes. The hills, which, for lack of a better name, may be termed the Lime Works Range, rising to a height of 400 ft. above the general level, overlook this country on the western side. These hills contain a deposit of high-grade iron ore, which, if it is ever fully developed, may prove to be one of the largest in the whole world. The limestone which is burned at the lime works is enclosed on two sides by the banded ironstone, folded back upon itself. The limestone has not been proved to continue as a bed along the range.

Diamonds in Portuguese East Africa.—A company has been registered at Pretoria with a capital of £10,000 in £1 shares for the purpose of prospecting a diamondiferous alluvial area on the Zangwe River in Mozambique, Portuguese East Africa. It is reported that two small diamonds have been found in the area. Samples of the gravel have been brought to Johannesburg, and it is understood that prospecting operations will be commenced on the Zangwe at an early date, under the supervision of one of the Rand's leading experts.

BRISBANE

April 17.

Mount Isa Mines.—It now appears that the recent break in the Northern Railway not only interfered with the delivery of coal at Mount Isa, but also delayed the transport of machinery. The management, however, hope to start production about January next, or four months later than was expected when the original programme was planned. During the past two or three weeks the water in the mine, which had already been heavy, increased considerably, and caused further delay. Indeed, the flow is now so great that there is some reason for regret that so heavy an expenditure has been incurred in the Rifle Creek dam, which is now full and holds 1,400,000,000 gallons of water. This supply alone is sufficient to meet all mining and domestic needs for over two years, but it is expected rainfalls during that period will so add to the quantity stored that this period will be much lengthened. Complete railway communication with Mount Isa was restored early in March, and normal conditions were then established on the mining field. Operations were resumed at the main haulage shaft, which by the end of the month had reached a depth of 472 ft. A start was made to deepen No. 46 shaft to connect it with the No. 3 main haulage level. Cross-cutting proceeded at the man and supply shaft, but excessive water proved a hindrance. At Lawlor's and Doherty's shafts bailing has been in progress, while at Davidson's work has been carried out in three levels. The diamond drilling campaign has been continued, and a lot of additional construction work carried out in connexion with the mill, smelters, and power-house. By the end of February the pipe-line to convey water from the Rifle Creek dam had been laid a distance of 15 miles, leaving five miles more to be put down.

North Queensland Mining.—It is reported that the Whitworth Finance and Mining Company, a London venture that has been operating in the Herberton tinfield, North Queensland, for over twelve months, is closing down, but nothing definite is officially known as to whether the stoppage is permanent or only temporary. The stoppage has probably been brought about by the low price of tin. It is, however, stated that the owner of Wyatt's lease, which the company had been working under a twelve months' option, has received notice that the

work there would be suspended indefinitely, while advice has been received from Herberton that the corporation, acting under instructions from London, has given a month's notice to its employees. At the same time, it is rumoured that another company is ready to take over the Wyatt lease in the event of the Whitworth Company closing down permanently.

The production of copper, as well as of silver-lead, in both the Herberton and Chillagoe mineral fields, forming the hinterland of the port of Cairns, has been much stimulated by the reopening of the Chillagoe State smelters, which are now in regular operation. As a result, there has of late been a marked improvement in the monthly return of minerals from this important mining centre.

The Coal Stoppage.—The thirteenth month of the coal stoppage in New South Wales has passed, and the trouble is still unsettled. The owners, who three or four weeks ago arranged to open their mines with either union or free labour, whichever might be available, held their hands pending the result, first of another conference and then of a labour convention. Nothing eventuated; mass meetings of labour unions have again rejected the owners' terms, and preparations are now being matured for an early resumption of operations at some of the idle mines with any labour offering. The re-starting is expected to begin next week, after Easter, but the owners say it will be impossible to re-engage immediately all the men formerly employed, even if they offer. As one result of the stoppage, official returns show that the export of coal from Newcastle in the first quarter of this year was only 122,882 tons, or less than one-fifth of the quantity exported for the corresponding period of last year.

Coal Commission Report.—A Royal Commission on the coal industry that has been sitting for a long while in New South Wales has at last issued its report. Its main recommendations are the fixing of the prices of coal as well as wages, the granting to all coal mines of licenses, which could be withdrawn for any just cause, and the appointment of a board to carry out these objects. The Commission's report has not been received with favour, and it would not be surprising if nothing further is heard of it.

Australian and New Guinea Oil Prospecting.—It is estimated that something approaching £1,000,000 has been spent

on prospecting for oil in Queensland. As a result of this expenditure, it has been proved beyond doubt that oil exists both in the Roma district, in the southern part of the State, and in the central district at Longreach; also petroliferous gas at Roma. The oil flow at Roma, however, has never reached more than a few gallons a day, and gas has not appeared in sufficient quantity to make the extraction of oil from it a commercial proposition. In 18 months the number of bores being sunk has fallen from about twenty to eight or ten. In Victoria, encouraging indications have for some time been met with in oil boring at Lakes Entrance, and a company operating there has just announced that it is in a position to produce crude oil, but that the hole has been temporarily closed pending a visit by directors of the company and Government officials. The Netherlands Petroleum Company is to commence oil exploration activities in New Guinea this month.

Mining in Western Australia.—The model sampling plant lately installed on Chaffer's Mine, Lake View and Star, Kalgoorlie, is now in operation. The machinery, which is handling 400 tons of tributers' ore a day, is the most modern obtainable. It deals mainly with the ore of tributers, but is also used by the company for sampling. The directors of Golden Butterfly Mines, N.L., have granted to Mr. W. S. Robinson, representing Austral Development, Ltd., an option over the company's property and plant at Norseman. The terms provide for examination and development of the mine for not more than 18 months, and for the purchase of the mine and plant for £85,000 in cash, or, alternatively, £40,000 in cash and 55,000 fully paid £1 shares in a company to be formed by the purchasers.

Amalgamated Zinc Company.—For the six months ended December 21 a net profit of £10,067 was earned by Amalgamated Zinc (De Bavay's), Ltd., against £593 for the preceding term. The dividend rate of 8% has been retained. This company ceased treatment operations at Broken Hill some years ago, and part of its funds were used in proving that newsprint and other paper could be manufactured from hardwood grown in southern Tasmania. These experiments are reported to have been successful, but the intervention of the present financial depression has delayed the flotation of an operating company.

PERTH

April 26.

The Gold Discovery near Edjudina.—Considerable excitement has been evinced in the new find within six miles of the old Edjudina field, and 136 miles north-east of Kalgoorlie. One of the companies which was floated during the oil boom several years ago has had a prospecting party out for some months, and their prospector, testing a bold outcrop of quartz, found coarse gold at a number of different points and pegged out eight leases for his company. Since then a number of other leases have been pegged and taken on option by small Adelaide companies whose shares have jumped from being of no marketable value to 10s. in the course of a week. Mr. J. S. Allen, a mining engineer of Perth, made a preliminary inspection of the new find and has expressed himself pleased with its possibilities. The Government has despatched the Inspector of Mines for Kalgoorlie and one of the members of the Geological Survey to report. These reports should be available next week. The writer, although he has not seen this particular find, knows the Edjudina district well, and despite the optimistic reports prevalent in Perth and Kalgoorlie is of opinion that the gold will cut out at a very shallow level. The gold occurs in a bucky quartz in coarse pieces, said to be as large as grains of wheat, but although schist occurs near the quartz, no reference has been made to gold having been found in it. In no case in the writer's knowledge in Western Australia has gold occurring in such geological conditions lived down. The Mines Department are to be congratulated in sending representatives of two of its branches (Mines Inspection and Geological Survey) out so promptly, and their reports should do much to clear the air.

A Tin Discovery.—For some time past isolated parties of prospectors have been at work in Kimberley in the far north-west of this State. A report has come to hand that a discovery of rich alluvial and lode tin has been made some 100 odd miles from Derby near the Kimberley Downs Station, and a tin expert from Malaya has been up to report, and it is understood that he is favourably impressed with the possibilities of the find. Kimberley is a country of great mineral potentiality, but it is so rugged and inaccessible that prospecting is difficult. The Kimberley Exploration Syndicate is

now mapping out the mineral areas in the concession of one million acres which they have obtained from the Mines Department. When the geological party have finished mapping, prospectors will follow them and test the sections which offer the greatest possibilities.

Prospecting Conditions.—In recent years the Western Australia Mines Department has offered many inducements to Syndicates which are prepared to undertake prospecting work on scientific lines, and their officers are always made available for advice and inspection. The State Mining Board which consists of the State Mining Engineer, the Government Geologist, the Under Secretary for Mines, a miner and a mining engineer, has been able by keeping in touch with all the prospectors in the field to do much to help on this work.

Progress at the Gold Mines.—Now that the railway is in operation between Geraldton and Wiluna, the machinery and plant for the Wiluna mines is being rushed forward and erected with all possible speed. The assistance granted by guarantees from the Commonwealth and State Governments will, it is hoped, allow the big treatment plant, which is necessary for economical work to be completed as early as possible. 40,000 tons a month of 36s. gold ore will be a valuable help to the gold output of the State. The re-treatment of the tailing from the Golden Horseshoe mine is proceeding satisfactorily. The results of the recent exploratory development work on the Golden Horseshoe mine and Lake View mine together with the improvements to their plant will also increase the gold yield. If the people of Australia would all work harder and spend less on luxuries, within a short time, she would soon recover the trade balance. The present ultra-high protective tariff and trade restrictions tend to increase living costs, while they reduce the revenue to the Government. Thus, while the mining companies and other primary producers are doing their best to create exportable materials, they are heavily penalized for the benefit of the secondary industries in the cities.

New Power Plant.—The Westralian Amalgamated Collieries are erecting a central power plant and will utilize powdered coal. Not only will they supply electric power for their own five collieries, but will supply current to all the district within a radius of fifty miles from Collie.

VANCOUVER

May 10.

Annual Report of the Minister of Mines for 1929.—The Annual Report will be issued during the last week in May. The Provincial Mineralogist, Mr. J. D. Galloway, who compiled it, has kindly given your correspondent advance sheets of his summary for the purpose of this news-letter, so he is able to give a brief review of the chief events of last year. The total value of the mineral production, \$68,245,443, fell short of the preliminary estimate, \$70,030,976, which was computed on the operations for the first 10 months and issued by the Department of Mines in last December, because of the decline in silver and zinc prices and of curtailment of operations owing to a shortage of hydro-electric power brought about by the prolonged drought which was not relieved until the end of the year. The production was made up of 152,322 oz. of gold, 9,918,800 oz. of silver, 101,483,857 lb. of copper, 302,346,268 lb. of lead, 172,096,841 lb. of zinc, 2,251,252 long tons of coal, miscellaneous metals and minerals to the value of \$1,773,845, and structural material to the value of \$3,921,786. This compares with a production of 196,511 oz. of gold, 10,627,167 oz. of silver, 93,908,316 lb. of copper, 305,140,792 lb. of lead, 181,763,147 lb. of zinc, 2,526,702 long tons of coal, miscellaneous metals and minerals to the value of \$905,354 and structural materials to the value of \$3,408,686 in 1928. The prominent feature of last year's production compared with that of the previous year is the marked increase in the production of copper, which was due to the higher market value spurring the operators to greater production, and which at the same time enabled them to mine and treat a considerable tonnage of low-grade ore that had been left in the mines when copper prices were ranging about 13 cents. The average copper content of the ore treated at Britannia was 1.24%, that at Anyox 1.19%, and that at Allenby 1.46%. The tendency to treat ores of lower grade was true also of the silver-lead-zinc and the silver-gold mine operators. The total amount of ore treated was 6,977,681 tons of an average gross value of approximately \$7.35 per ton, or 11.8% greater tonnage and 5.1% less value per ton than in 1928. The shortfall in the gold production was due to decreased production of that metal from the

Premier mine and to practically total cessation of productive mining in the Rossland camps. Shortage of power, trouble with the electrolyte at the Tadanac smelter, and the slump in the price of the metal toward the end of the year, combined to reduce what otherwise would have been a much larger zinc output. In recent years the Consolidated Company has shipped to foreign plants the zinc concentrate it was unable from shortage of electric current to treat; last year it stored it, and a large quantity has been accumulated at the smelter. A large amount of development and exploration was done during the year and the Ferguson, Big Missouri, Toric, Emerald, Mammoth, B.C. Silver, Reeves McDonald, Tulsequah Chief, and Manville mines were advanced nearer to the shipping stage. While the slump in the stock market stopped a good deal of development, much of it of a doubtful character, the big development companies are as keen as ever to take up any property of promise if reasonable terms are offered. Mr. Galloway does not expect the development of the industry to suffer from the stock market slump. Mining and metallurgical companies operating in the Province disbursed \$13,743,308 in dividends during the year, an advance of \$2,186,620 over the previous year. Larger dividends by the Granby and Howe Sound companies chiefly were responsible for the increase.

Alice Arm.—Britannia Mining and Smelting Company has suspended work at the Toric mine after developing a large tonnage of low-grade silver ore. No announcement has been made as to the company's intentions with regard to the property, but unquestionably the present uncertain condition of the silver market is the cause of the suspension. Britannia has not given out any information as to the result of its samplings as work proceeded; Toric Mines stated the ore had a value of about \$12 per ton when the price of silver was 56 cents per oz. Some 90% of the stock of Toric Mines is said to be owned in England. Dalhousie Mining Company has acquired the Tidewater molybdenum mine, situated across the inlet from the settlement of Alice Arm, and has started to drive a tunnel to develop the shear-zone at an additional depth of 100 ft. and to build a wharf and ore-bunkers. Surface exploration has exposed a wide shear-zone, in which rich bands of high-grade molybdenite-ore occur. It is understood that a maker of alloy tool steel at Sheffield is behind the venture.

Anyox.—The annual report of Granby Consolidated Mining, Smelting and Power Company states that marked improvements were made in the concentration of the ore at Anyox and that notwithstanding the treatment of a much larger tonnage of a lower grade of ore than in 1928 the copper recovery was improved from 86.54 to 91.65%. At its three mines, Bonanza, Copper Mountain, and Hidden Creek, the company produced 2,614,625 tons of ore which yielded 60,854,591 lb. of copper, 428,496 oz. of silver, and 10,558 oz. of gold. The average cost of copper production after allowing credits for precious metals and miscellaneous income, but before depreciation, depletion, and income taxes, was 10.614 cents per lb., or 1.416 cents more than in the previous year, the higher cost being due to the higher wage-scale paid. The ore reserves at the end of the year stood at 14,341,970, as compared with 14,713,132 at the end of 1928. Though no mention of it is made in the report, it is no secret that most of the 2,243,463 tons of new ore developed was at the Copper Mountain mine. After allowing \$1,372,599.52 for depreciation, and \$785,083.57 for depletion, the company made a net profit of \$2,021,412.80 and distributed to its shareholders \$2,149,777.92 as return of capital from its earnings and from depletion and depreciation reserve.

Britannia Beach.—Britannia Mining and Smelting Company still further increased its rate of copper production by turning out 11,753,009 lb., as compared with 11,190,782 lb. in the last quarter of 1929. The mill is treating between 6,000 and 7,000 tons of ore daily and has on occasions exceeded the latter figure.

The Kootenays.—With the exception of the Sullivan and the Monarch, all silver-lead-zinc mills are idle, but development is being carried on at several properties, and a little development ore is being shipped. Mr. J. J. Warren, president of Consolidated Mining and Smelting Company, on a recent visit of inspection to the Sullivan mine, in the absence of Mr. S. G. Blaylock, who is convalescing at his home from a recent operation, and Mr. W. M. Archibald, who is attending the Congress in South Africa, said that, though he did not expect any improvement in metal prices this year, there will be no reduction either in the wage-rate or in the number of men employed, in fact, he expected the latter would be increased. He has since made the announcement that a

bore-hole has penetrated the extension of the Sullivan vein on a horizon 1,000 ft. vertically below the present bottom tunnel, which proves its extension for about 2,000 ft. on the dip of the vein. The size and grade are commercial at point of intersection. Mr. Warren further announced that his company will be in a position to distribute its "triple super-phosphate" fertilizer in the Prairie Provinces in time for seeding in the spring of next year. Reno Gold Mines, most of the stock of which is owned in England, treated 640 tons in March and produced 980 oz. of bullion, valued at \$14,554. The mine continues to develop well and the company proposes to increase the capacity of the mill in the summer. The Provincial Water Board has given the West Kootenay Power and Light Company permission to go ahead with the surveys for the two dams on the Pend d'Oreille River, instead of the one, and has ruled Reeves-McDonald Mines objection to the scheme out of order, but has given that company the right to protest again when West Kootenay's final plans for the development of the river have been filed. The company has until August 31 next in which to submit plans for the upper dam and until the end of the year for the lower dam. It may decide to develop the river either by one huge dam, 365 ft. high, at the point just above where it emerges into the Columbia River, or by a 150 ft. dam at this point and one 165 ft. high seven miles higher up the river. The company expects to develop 300,000 h.p., a large proportion of which will be needed at the fertilizer plant.

TORONTO

May 16.

Sudbury District.—Base metal mining has been seriously affected by the continued decline in the price of copper, which has materially lessened the earnings of producing companies and discouraged new ventures. The International Nickel Company reported net profits for the three months ending March 31 as \$4,616,144, as compared with \$5,390,191 for the corresponding period of last year. As the company is mainly concerned with the production of nickel and has also good returns from precious metals, from which it is able to realize large profits it can afford to regard the copper content as a by-product. It is announced that market conditions will in no way interfere with the

company's programme for development and construction. The new smelter is nearing completion, the new coal pulverizing plant has already been tested, and it is expected that the first reverberatory furnace will be started in a few days. For some time, however, it will be necessary to continue the shipment of nickel-copper matte for treatment at the Port Colbourne refinery. Good progress has also been made with the construction of the copper refinery of the Ontario Refinery Company at Copper Cliff, which is expected to be ready for operation about July. The Falconbridge is stated to be realizing a profit of about \$50,000 per month. Underground conditions continue satisfactory, and the company is working towards the objective of 1,000 tons a day when the supply of power promised by the Ontario Government becomes available. The Treadwell Yukon is carrying its workings to a lower horizon, shaft No. 2 having been put down to the 1,200 ft. level, where a station has been cut, its objective being 1,500 ft. Cross-cutting to the ore-zone is under way. Improvements in the methods of treating the ore have resulted in considerably increasing the recovery of zinc, lead, gold and silver. The Sudbury Exploration and Mining Syndicate which owns five claims east of the Falconbridge property is preparing to sink a shaft and carry out an extensive development programme. Diamond drilling by Sudbury Basin on its Vermilion Lake property has indicated a considerable extension of its known ore-bodies.

Porcupine.—During the month of April the seven producing mines of Porcupine yielded bullion to the value of \$1,561,925, as compared with \$1,464,947 for March. Hollinger Consolidated during the past few months has been successful in developing a higher grade of ore, the gold content being stated to be nearly \$7 to the ton. Development work has disclosed a considerable tonnage of mill ore which will run from \$6 to \$7 to the ton. For the first three months of this year the average grade was \$6.42. Since the fire at the Dome Mines, work has been chiefly centred on mine development, and good progress has been made. Orders for material and equipment have been placed in connexion with the construction of the new 1,500 ton mill, and delivery has been arranged on a basis to permit of the utmost speed on the actual work of construction and installation. It is hoped that it will be

completed so that the company can go into full production during the closing quarter of the year. Present known ore reserves of about 1,600,000 tons are at least three years ahead of mill requirements. The McIntyre has recently increased its ore reserves by important new discoveries. No. 3 vein has opened up exceptionally well on the 15th and 16th levels, the width running from 9 to 10 ft., with an average grade of \$8.50 to the ton. The vein system around No. 11 shaft is also improving. The directors are studying the requirements of the new mill, an announcement respecting which will be made shortly. The mill of the Vipond is treating about 300 tons of ore a day, producing approximately \$70,000 per month, and development is being carried on at depth. The Coniaurum is stated to be operating at a profit, with a production of \$2,000 daily. A winze is being sunk below the 2,000 ft. horizon, which will prepare the way for an aggressive development campaign at depth. The Canusa Mining and Exploration Co. is resuming operations on its property in South Porcupine, and will carry on an extensive drilling campaign.

Kirkland Lake.—The bullion output of this field during April was valued at \$1,393,520, being \$93,696 below that of March, which was a record month. The mill of the Lake Shore during the first three months of the year treated 128,957 tons of ore, with a recovery of \$1,745,000. The mill additions which will increase the tonnage to 2,000 tons per day are now nearly completed and should be ready for operation by the end of June. The hoisting capacity will be increased to permit of the sinking of the shaft to a depth of 4,000 ft. Underground development at the 1,600, 2,000, and 2,300 ft. levels is largely increasing the ore reserves. On the 1,600 ft. level over 2,500 ft. of stopes are being opened up. Cross-cutting on the 2,000 ft. level has shown the vein to have a width of at least 35 ft., and a subsidiary vein of good grade 6 ft. wide has been found on the 2,200 ft. level. The Teck-Hughes has started work on the erection of its mill additions, which will have a capacity of 300 tons. Ore is being drawn from the upper levels and shows some improvement in values. The six new levels recently established at depth are still undeveloped, but preparations are under way to sink to lower horizons and cut five new levels. The Wright-Hargreaves is steadily improving its position, and increasing its rate of production. The

downward continuation of the ore has been proved to a depth of 3,000 ft., and as there has been marked improvement in the vein-structure and ore-values as development proceeded to the lower levels, there is every reason to believe that the ore deposition continues to greater depths. The Kirkland Lake gold mine is actively pushing work on the 3,600, 3,975, and 4,000 ft. levels. Production during April showed a marked increase, the output being upwards of \$53,000, the mill handling considerable high-grade ore from the lower levels. A winze has been sunk to a depth of 4,150 ft., where a station is being cut. The Barry Hollinger has opened up considerable high-grade ore on the 1,615 ft. level. The shaft is to be carried to a depth of 1,850 ft. A rise from the 1,625 ft. level to the 1,500 ft. shows the upward continuation of the ore. Diamond drilling on the Swastika has been attended with favourable results, showing mineralization carrying gold and copper values. Amity copper has ceased operation owing to the unfavourable copper situation. The company has been opening up good ore on the 1,000 ft. level and the original programme may be carried out should the market improve sufficiently.

Rouyn.—Activities in this field show a marked falling off as few of the properties in the initial stages of development offer much promise of being practically worked, with copper at its present low price. The Noranda is carrying out a deep development programme, and devoting much attention to the opening up of its gold-ore deposits. Drilling is now under way from the 975 ft. level to explore for the downward extension of the rich gold ore-body encountered on the 825 ft. level. No. 3 shaft, now at 1,300 ft., will be deepened to 1,500 ft., where it will be connected with No. 4 shaft, and a deep drilling campaign will be carried out from that horizon. The Granada will shortly enter upon the production stage, the mill being nearly completed, being expected to be ready for operation about the middle of next month, when it will handle at the outset about 50 tons daily, which will be gradually stepped up to 200 tons. It is officially announced that the Abana will make no change in its plans for mill construction, much of its ore reserve being sufficiently rich for profitable handling even at present prices. The Waite Montgomery is carrying out operations at the 700 ft. level, taking out good ore, and will carry

out a diamond drilling campaign at this level to test the ore-bodies at depth. The Newbec, which during the winter shipped six cartloads of ore to the smelter, is putting down a winze from the 250 ft. level to a depth of 375 ft.

Patricia District.—The mill of the Howey has gone into regular operation with results satisfactory to the management, and operating costs are reported to be low. On the property of the McManus Red Lake Mines, Ltd., a vein 10 ft. in width carrying good commercial values has been opened up. The Red Lake Centre Mines, close to the Howey, is reported to have struck a continuation of a break from the latter, showing favourable mineralization. Prospecting is being carried on actively throughout the district, being greatly aided by the air service which is now in operation for the season.

Manitoba.—The five-compartment shaft of the Flin Flon is nearly completed down to the 1,000 ft. level and work has been commenced on the 650 ft. level, from which at the outset much of the ore sent to the concentrator will be drawn, while a large tonnage will be taken from a glory hole on the surface. At the Sherritt-Gordon operations are progressing steadily in making the mine ready for a large tonnage. At the 250 ft. level a station has been cut where a large crusher will be installed. Lateral work is progressing at the 375 and 500 ft. level, the ore opened up on the latter showing increased copper content. Other companies which are carrying on aggressive operations in this section are the Mandy, Gem Lake, and Great Northern Lake Mining Co. The Winnipeg River Tin Mines, operating in the southern section of the Province, will start work immediately on their claims recently acquired from the Warner Lake Mines. Work will be concentrated on the opening up of the lithium deposits in view of the activity which characterizes the market for this metal.

CAMBORNE

June 4.

The Price of Tin.—At the time of writing the metal is quoted at about £136 cash, the lowest price recorded since 1914. At this price all interested in the tin mining industry are experiencing a period of unusual anxiety, not in Cornwall alone. During 1929 the average price of tin metal was about £204

per ton. In the financial year ended December 31 South Crofty made a profit of £7,838, and East Pool and Agar a profit of £7,404. The financial year at Geevor ended on March 31, and the profit on the year's working was £9,458. With tin at its present price it is evident that no tin mine in Cornwall can pay its way. Fortunately, each of the three above-mentioned properties possesses a substantial cash reserve and, in addition, has so conducted development that extensive ore reserves have been laid open. Other tin mines in the county are in a less fortunate position financially, and some of the newer companies have not yet had sufficient time in which to open up extensive reserves of ore ground.

Effects upon Labour.—Should existing conditions be prolonged, it must become necessary for the majority of the mines to consider the advisability of suspending milling operations, and confining underground work to the more important points of development, until tin recovers in price. Already the numbers of persons employed have been temporarily reduced in several mines. For example, Geevor announces that during repairs to the air-compressor and installation of large air-main in Victory Shaft, now specially taken in hand, certain portions of the underground operations are necessarily suspended. During the severe depression of 1922-23 the lowest point recorded for tin metal was £139 per ton, and milling was suspended in all the mines in Cornwall for a time.

Restriction of Output.—Locally the results of the restriction policy of the Tin Producers' Association are regarded as very disappointing so far, but hopes are entertained that the new committee, specially appointed recently, will be successful in inducing producers in general to adopt—in practice—the curtailment scheme of the Association. In any case, the rate at which "assets" vanish from alluvial deposits, when production is forced and tin metal is at £136 per ton, will be sufficiently rapid to compel concentration of thought, and probably unison of action.

Prospecting.—Notwithstanding unremunerative prices for tin, prospecting in the county has not entirely ceased, and, in two or three very promising instances, provision has been adequately made for action when the proper time comes.

It may be emphasized here that no useful purpose is served by exaggerated reports of extraordinary discoveries! Quite recently

reports relating to a new lode 5 to 6 ft. wide with "an average yield of 11.5% of tin," and "a favourable lode of wolfram averaging about 45%," have got into circulation. When it is considered that the average yield of South Crofty, East Pool, and Geevor mines, the three largest and most productive mines in Cornwall, is about 1¼% of black tin (SnO₂), and that the yield of the only wolfram mine at work in the county, Castle-an-Dinas, is not quite 2% of WO₃, it should not be difficult to discount such reports as those referred to!

PERSONAL

- R. B. ASH has left for Canada.
 H. FOSTER BAIN passed through London on his way to the Continent.
 A. BECKERLEG has left for Panama.
 A. E. BIDLAKE is home from Nigeria.
 STANLEY C. BULLOCK is returning from Uganda.
 G. W. CAMPION is home from West Africa.
 LANGSLOW COCK is here from Nigeria.
 P. C. COLLINS has left for the Gold Coast.
 E. CURNOW is home from Nigeria.
 DONALD FOSTER has left for Panama.
 HUGH GEMMELL has left for Malaya.
 D. GILCHRIST has left for Northern Rhodesia.
 H. C. HERBERT is returning from Northern Rhodesia.
 ROSS B. HOFFMANN is here from the United States.
 W. BROOKE HOWARD has returned from Tanganyika.
 W. J. HUGHES is returning from Nyasaland.
 E. C. KNUCKEY is home from India.
 F. H. LATHBURY is home from Kenya.
 H. A. LAVERS is home from Southern Rhodesia.
 F. H. LIVENS has retired from the position of Chief Engineer to Ruston and Hornsby, Ltd., after 54 years' service. He remains vice-chairman.
 STANLEY LOW has left for Panama.
 R. MELLON is returning from India.
 THOMAS PRYOR is leaving on a short visit to Asia Minor.
 PHILIP RABONE is returning from Rhodesia.
 HORACE P. ROBERTSON has left for East Africa.
 A. B. ROWE has left for Spain.
 JAMES RUSSELL is home from Bolivia.
 F. B. WADE is home from Tanganyika.
 G. A. WALLIS is home from Northern Rhodesia.
 H. H. WATSON is returning from Panama.
 W. J. WELLINGTON has left for Spain.

SIR FREDERICK BLACK died on June 7 at the age of 68. He was prominent in the oil industry in recent years and president of the Institution of Petroleum Technologists in 1919.

WILLIAM DEWAR died on May 29 at the age of 58. After being assistant professor of metallurgy at the Glasgow and West of Scotland Technical College from 1891 to 1892, he had a wide and varied career in Australia, Colombia, France, and subsequently as consultant in London.

W. A. QUINCE has died in West Africa, aged 42, as the result of an accident while inspecting the Ariston mine. Mr. Quince, with two other men, was gassed in an attempt to rescue the Chief Surveyor.

TRADE PARAGRAPHS

Head, Wrightson and Co., Ltd., of Stockton-on-Tees, send us a booklet describing the Skinner roasting furnace, which is one of the superimposed hearth types with mechanically operated rabblers.

Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, issue literature devoted to flameproof induction motors of both squirrel-cage and slip-ring types for 2 and 3 phase circuits up to 600 volts, with power ranges of $1\frac{1}{2}$ to 140 h.p.

W. and T. Avery, Ltd., of Birmingham, makers of weighing machinery and measuring equipment of all kinds, are celebrating the bi-centenary of their organization in July, in connexion with which a number of interesting events are to be arranged.

Drayton Regulator and Instrument Co., Ltd., of West Drayton, Middlesex, send us leaflets devoted to heavy duty industrial steam traps, differential steam traps, a portable gas calorimeter, float operated electric switches, and room type temperature recorders.

Demag, of Duisburg, Germany, send us the April issue of their *Demag News*, which contains an article on compressors at different altitudes and depths, which deals with the influence on power consumption of the atmospheric pressure at which the compressor is working.

W. F. Johnson and Co., of 14-15, Farringdon Road, London, E.C. 1, general agents for the Palmetto brand and other packings manufactured by Greene, Tweed and Co., send us a wall chart which indicates which of four types of packings should be used in pumps dealing with a variety of liquids and gases.

G. A. Harvey and Co. (London), Ltd., of Woolwich Road, London, S.E. 7, inform us that they have just completed the first of an order for welded mild steel transformer tanks for working at a capacity of 15,000 k.v.a., 132,000 volts, 50 cycles, 3 phase, for use in connexion with the Central Electricity Board scheme for South-East England.

Transporting Machinery and Engineering Co., Ltd., 76, Victoria Street, London, S.W. 1, issue a fully illustrated catalogue covering some thirty pages describing Bleichert bicable aerial ropeways. This deals with general principles, the eight main types of bicable, the track, the drive, the ropeway cars, loading and unloading, and design, material and workmanship. Examples of a great number of installations are contained in the many photographs published.

Ruston-Bucyrus, Ltd., of Lincoln, send us folders relating to the development of the products of the two companies from 1874 to the present time. They have also published a catalogue which illustrates and describes a large number of the machines which the joint organization offers. These include $\frac{1}{2}$ yd., $\frac{3}{4}$ yd., $\frac{5}{8}$ yd., $\frac{7}{8}$ -1 yd., $1\frac{1}{4}$ yd., $1\frac{1}{2}$ yd., 2 yd., 2 $\frac{1}{2}$ and 3, 4, and 5 yd., as well as big machines from 6 to 16 yd., all of which sizes are made in both shovel and dragline forms. Particulars have also been included in the catalogue of dredges of a variety of types as manufactured by the Bucyrus Company.

Norris, Henty and Gardners, Ltd., of Patricroft, Lancs., send us a catalogue describing their new high-speed oil engine, which has been designed to meet the demand for a

compression-ignition engine of the same power-weight ratio as that of the average petrol-paraffin engine. Running at a speed of 1,000 r.p.m., the engine gives $9\frac{1}{2}$ b.h.p. per cylinder with fuel consumption of less than 0.41 lb. per b.h.p. hour. The engine can be run at higher speeds except for continuous heavy duty. It is built with any number of cylinders from 1 to 6, including 5. The catalogue very completely describes the engine and its parts, and is also illustrated with photographs and cross-sectional drawings.

British Goodrich Rubber Co., Ltd., of 50, Pall Mall, London, S.W. 1, have issued a leaflet, describing their rubber-lined, relinable valve, which is a special application of a well-known principle, that of a laboratory screw clamp such as is used to stop the flow of liquid in rubber tubing. This method of squeezing a soft rubber tube produces a positive shut-off. As will be seen from the



accompanying illustration the soft rubber liner is so shaped that there is a minimum of distortion at the point of compression, and being completely surrounded by the reinforcing casting, static pressures up to 100 lb. may be safely used. The liner is, moreover, easily replaceable. These valves are especially suitable in systems where solids are being carried in liquid streams, as for example in water concentration plants.

Mining and Industrial Equipment, Ltd., of 11, Southampton Row, London, W.C. 1, report that new orders have been received for the following equipment: For England: Two 2 ft. by 4 in., type 27, screens for sand to $\frac{1}{2}$ in. and $\frac{1}{4}$ in.; one 4 ft. by 5 ft., type 39, screens for foundry sand to $\frac{3}{8}$ in. at 25 tons per hour; one 7 ft. Raymond air separating plant for carbonate of magnesia to 100% through 100 mesh sieve at 2,800 lb. per hour; one Ro-tap sieve shaker and one No. 3 Raymond pulverizer for hydrated lime at 5 tons per hour to 90% - 200 mesh. For Scotland: one Ro-tap sieve shaker. For Yugo-Slavia: One Ro-tap sieve shaker. For France: One, type 37, Hummer screen for 60 tons per hour cement slurry containing 40% moisture; one 2-roller Raymond pulverizer for 1 ton per hour oxide of magnesia to 95% - 75; and one Hardinge mill for unnamed duty.

Peter Brotherhood, Ltd., of Peterborough, one of the associated companies of **Agricultural and General Engineers, Ltd.**, of Aldwych House, London, W.C. 2, have published a catalogue describing the Brotherhood Ricardo high-speed Diesel engine. This is a vertical engine which, among other applications, has been employed for driving Ransome-Rapier-Marion excavators. It is made in 2, 3, 4, 5, 6, and 8 cylinder types, in powers ranging from 100 to 400 b.h.p. at a normal running speed of 900 r.p.m. which may be increased to 1,000 r.p.m. for direct coupling to alternators. It is particularly light in weight, the standard 300 b.h.p. engine weighing only about 40 lb. per b.h.p., which weight may be considerably reduced in special cases where such is necessary. The

single-sleeve valve with which it is equipped is claimed to have many mechanical and thermodynamical advantages over the normal poppet valve in that it allows freedom in combustion chamber design, of which advantage is taken and low fuel consumption is the result.

Francois Cementation Co., Ltd., of Bentley Works, Doncaster, inform us that during March they completed the sinking and lining of a 16 ft. finished diameter shaft through water-bearing ground for the Coltness Iron Co., Ltd., at Kingshill, Scotland, to the final depth of 333 yds. The sinking and lining were carried out by the Francois processes. Immediately following the completion of the sinking they were awarded the contract for the excavation of the shaft bottom headings, and this work is in progress. They also inform us that the last stages of their contract with the Coltness Iron Co., for the cementation, sinking, and lining of two shafts at Overtown, Scotland, is approaching completion, the shafts being of the respective diameters of 14 ft. and 11 ft. and they will be carried to the same depth as at Kingshill. The contract has also just been secured with Messrs. Lockwood and Elliott for the enlargement of their 10 ft. diameter shaft at Shuttle Eye colliery, near Wakefield, to 14 ft. in diameter from the surface to 79 yards, and carrying it deeper to the depth of approximately 190 yards. Preparations for the commencement of this work are in hand.

The Wallwin Company, of Saltisford Ironworks, Warwick, have issued a catalogue of their unchokeable pumps to which some reference was made in connexion with their exhibit at the Public Works, Roads and Transport Exhibition in December last. These pumps are designed for the efficient handling of water-borne sands or other solids and we reproduce here a photograph of the interior showing the essential part—the impeller (Fig. 1). The blade of this impeller is so shaped with its slight twist that it grips the incoming particles before projection and tends to direct all solids and semi-solids away from the front-end plate, thus reducing friction and increasing

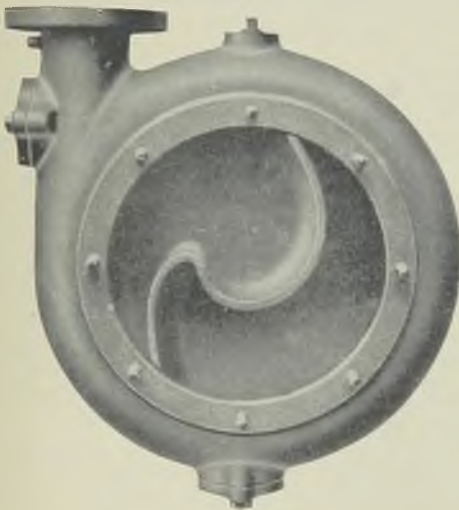


FIG. 1.

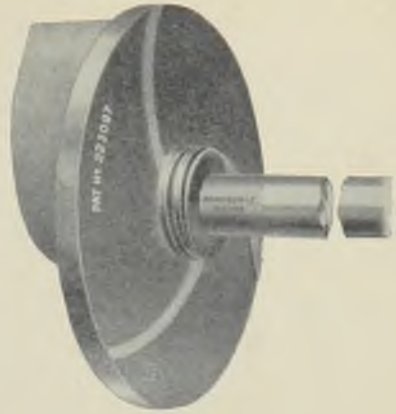


FIG. 2.

efficiency. The impeller is balanced under all loads. Another feature is the helical grit repeller illustrated in Fig. 2. This device creates a constant opposing current against the pressure at the packing gland which tends to preserve inert liquid there and to prevent the constant accumulation of grit around the shaft. These pumps are made in both horizontal and vertical types and may be belt-driven or direct coupled to the prime mover.

HADFIELD'S DREDGE PARTS

Arising out of E. J. Vallentine's paper before the Institution as abstracted on p. 120 of our February issue, Hadfields, Ltd., of Sheffield, write us extensively as to the parts which they make for dredge builders. They point out that while the author of the paper evidently writes from wide practical knowledge of the operative side of the subject, they, as extensive manufacturers of the various steel castings and forgings which enter into the construction and maintenance of dredges, have opportunities for considering the trend of development in the design of certain of the dredge parts, which prompts them to offer a few comments in amplification of some of Mr. Vallentine's statements.

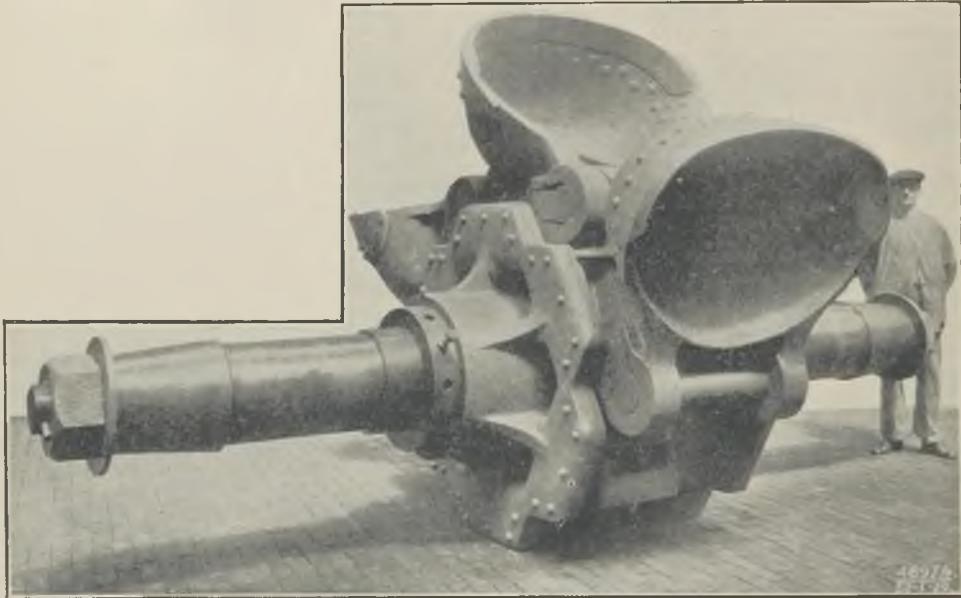
It may be said generally that, following the impetus given to the placer dredging industry by the recent phenomenal developments in tin dredging in the East, coupled with the greater experience of the dredge engineer in dealing with the difficulties which present themselves, and the skill of the modern metallurgist in devising special steel to meet the various working conditions, the design of many of the parts is more or less in the state of evolution. This is particularly noticeable in the case of bottom tumblers, the designs for which have been very numerous, but which in tin dredge practice are now generally circular and in the majority of cases in the form of some sort of external wearing part mounted on a permanent centre.

The external wearing part (or parts, as sometimes the provision against wear is by means of plates attached to the tumbler by bolting or riveting) is renewable, and so far as it goes the idea is a good one, but it is understood that no matter what device is utilized for fixing the protective piece or pieces there is always a tendency for them to

work loose. Should they do so and be in the form of plates, their object is at once defeated as they are liable to eat into the body of the tumbler, producing wear they are intended to avoid, while should a tumbler shell become loose, it produces its own operative difficulties and may result in stoppage of the dredge for tightening up. Separate wearing parts are therefore always liable to be a source of anxiety to the dredge master and may result in considerable losses in time and expense. For this reason, the attention of certain engineers has recently been turned to the possibility of obtaining a tumbler body cast in one piece. Naturally the material employed must be of a nature exceptionally resistant to wearing action. High carbon steel, as Mr. Vallentine says, has been employed, but it is suggested that the best material

deal of bumping and rough usage, and as these are just the conditions for which this special steel is particularly suitable, it is understood in practice to have proved thoroughly satisfactory for parts of this description.

The question of the flare and shape of the bucket lip was not sufficiently brought out in earlier days, but is carefully borne in mind in present day designs, as also the countersinking of the end rivets in the outside of the lip. The firm have made many designs of dredge buckets, but where clay has to be dealt with there is considerable favour for the "open-bowl" type, which fulfils the two essentials mentioned by Mr. Vallentine—ability to facilitate the discharge of clay and strength to stand up to the hard digging. The interior of this bucket in section, as illustrated by the



TOP TUMBLER AND BUCKETS FOR TIN DREDGE.

for the purpose is their patent "Era" manganese steel, and in view of his remark that the "British founder seems reluctant to cast one in solid manganese steel" it may be of interest to note that they have long specialized in this class of tumbler for harbour dredge work and following a demand from certain directions, are now producing them as solid castings in "Era" manganese steel for mining dredges. The manufacture of such tumblers is only possible as the result of long and specialized experience, but only recently a tumbler of this design as large as 7 ft. diameter by 3 ft. 1 $\frac{3}{4}$ in. wide over flanges was supplied, giving some idea as to what can be done.

In addition they are also producing top tumblers with bodies cast solid in manganese steel, and it may be that sometime these also will be generally adopted in tin dredge practice, thus avoiding the difficulties associated with independent tread plates. Ladder rollers are frequently called for and these are supplied in manganese steel as solid castings or as renewable sleeves. The ladder roller is essentially a part which comes in for a good

photograph reproduced here, approaches the circular in all directions much in the same way as the ordinary culinary basin, so that there are no angles or other features to impede the discharge. Many buckets of this type have been made and nothing seems to indicate they are fulfilling the requirements otherwise than satisfactorily. A new type of bucket incorporating means for positively assisting the discharge of the clay by hydraulic pressure may be heard of shortly. The idea of providing guide vanes on the back of the bucket to focus tipping and lessen side spill is thought to be a relatively new one, but buckets of this type have been made. The effect of locating the spill in this manner will probably be to increase the wear on the back of the bucket, and care must be taken to provide against this, as indeed it is in all their close-connected buckets.

A great deal could be written on the subject of pins and bushes—the types and shapes of bushes, the phenomenon of "flow" in bushes, the question of the fixing of the pins, the most suitable material for both pins and bushes, etc., which are constantly

receiving the attention of engineers, and of the manufacturers of dredge parts. One of their clients is regularly using pins of "Era" manganese steel of so large (relatively) a diameter as $5\frac{7}{8}$ in. by $30\frac{1}{2}$ in. long, for which from time to time repeat orders are received as necessity arises. Tin dredge engineers generally, however, seem to prefer the nickel chrome steel, and the tendency is to demand increasing hardness with a view to obtaining greater life from the pins. The danger in increasing the hardness is that it may give rise to brittleness, and nothing is more to be avoided in a dredge pin inasmuch as it may result in sudden fractures and the depositing of the string of buckets in the paddock. The ideal pin has evidently yet to be attained, but it may be of interest to note that, by careful study of the problem they have progressed a long way in the right direction, as they have now a steel—"Hecla 116"—on the market in which the hardness has been materially increased but which possesses the requisite degree of toughness to eliminate all fear of breakage under ordinary working conditions. As pins of this special steel can be supplied at a reasonable price, it is hoped that dredge engineers will find them of considerable assistance in reducing their ultimate working costs.

METAL MARKETS

COPPER.—A further reduction in the price of electrolytic copper was made by the chief American copper interests early in May, and the quotation, which opened at 14 cents per lb. in New York, was marked down to 12.50 cents. Subsequently, however, it was advanced again to 13 cents, at which level it remained throughout the remainder of the month. The recovery was made possible by the extremely heavy demand which manifested itself at the lowest level touched, but business has since become much quieter. The copper situation is undoubtedly healthier than it was, as the big American stocks must have been reduced somewhat in view of the unprecedentedly heavy sales which have been effected. Standard copper prices fluctuated, but recorded a small advance on the month.

Average price of Standard Cash Copper: May, 1930, £53 5s.; April, 1930, £62 3s. 3d.; May, 1929, £75 2s. 6d.; April, 1929, £81 2s. 7d.

TIN.—Except for short-lived rallies, the tendency of prices on this market was downwards during the past month, and quite a substantial further loss was recorded. The disappointing trend in the statistical position was obviously responsible for much of the pessimism which was evident, as it is difficult to take a cheerful view of any market when, in spite of frenzied efforts on the part of producers to control output, surplus stocks persist in increasing in an alarming fashion. Of course, prices look very cheap now and many mines are certainly finding them unremunerative so that economic causes are likely to curtail production in the immediate future much more efficiently than could ever be effected by an arbitrary decree of the Tin Producers' Association. World consumption is fairly good, although in view of the set-back to American industry, it is not as good as it was last year.

Average price of Cash Standard Tin: May, 1930, £144 18s.; April, 1930, £162 14s. 7d.; May, 1929, £197 12s. 8d.; April, 1929, £206 19s. 7d.

LEAD.—The London lead market was fairly firm throughout May, although the best quotations were not maintained. Despite an improvement in Continental interest, the general demand from consumers has only been moderate on the whole, apart from short-lived spurts of buying whenever prices looked particularly attractive. Arrivals of fresh metal have been on a full scale and stocks both in official and private warehouses are large. In these circumstances, the price is only prevented from falling by artificial support on the part of leading interests, and although the latter may be able to continue these tactics successfully, it is very doubtful whether they will be able to advance the quotation to any extent.

Average mean price of soft foreign lead: May, 1930, £17 16s. 6d.; April, 1930, £18 6s. 9d.; May, 1929, £23 16s. 11d.; April, 1929, £24 11s. 10d.

SPELTER.—Prices fluctuated within a moderate compass during the past month, but on balance showed little material modification at the close of May. Sentiment was rather depressed, although the demand from the brass trade tended to expand as a result of the cheaper price of copper. World supplies remained excessive and the renewed efforts to establish the Spelter Cartel met with but little success. Undoubtedly, however, output is being affected by the low price and sooner or later some sort of equilibrium should be restored even if the Cartel project does not materialize.

Average mean price of spelter: May, 1930, £16 19s. 8d.; April, 1930, £18 1s. 11d.; May, 1929, £26 13s. 4d.; April, 1929, £26 13s. 8d.

IRON AND STEEL.—Conditions on the Cleveland foundry pig-iron market became worse last month. More furnaces were blown out, but demand remained slack and surplus stocks were comparatively heavy. Makers, however, declared that they could not afford to modify their quotations and No. 3 foundry G.M.B. consequently remained at 67s. 6d. per ton, minimum. Hematite was an easy market, with East Coast Mixed Nos. priced at about 74s., but at the close of the month a British contract for 175,000 tons of hematite was secured by Messrs. Pease and Partners for delivery over five years and this may be expected to improve the situation. The demand for British finished iron and steel was only mediocre, but prices remained steady. Continental steel was dull.

ANTIMONY.—At the close of May, English regulus was in steady demand at between £40 and £46 10s. Business in Chinese material was moderate, spot regulus being quoted around £27 10s. to £28 ex warehouse and shipment metal at £24 10s. to £24 15s. c.i.f.

IRON ORE.—The idle conditions seen in April continued throughout May. No fresh buying was done as current contracts are providing more ore than ironmasters can cope with and deliveries are being delayed everywhere. A considerable number of blast furnaces have been blown out since the beginning of the year and the outlook for the next few months at any rate is far from promising. Prices are quite nominal at around 20s. c.i.f. for best Bilbao rubio.

ARSENIC.—Down to £15 15s. per ton f.o.r. mines is now accepted for 5-ton lots, business being slow.

BISMUTH.—Considerable Continental competition has been seen recently and the Bismuth Trust has reduced its official price to 4s. per lb. for 5 cwt. lots and over.

CADMIUM.—Demand, although moderate, has not made such a good showing as in the earlier

LONDON DAILY METAL PRICES

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

	COPPER.									TIN.				ZINC (Spelter).		LEAD.		SILVER.		GOLD.
	STANDARD.			ELECTRO-LYTIC.	BEST SELECTED.	CASH.		3 MONTHS.		CASH.	3 MONTHS.		£ s. d.	£ s. d.	SOFT FOREIGN.	ENGLISH.	CASH.	FORWARD.		
	Cash.	3 Months.				£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.							£ s. d.	
May	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
12	55 13 9	54 13 9	59 10 0	—	—	145 10 0	147 6 3	17 12 6	18 7 6	20 0 0	19 1/2	19 3/4	84 11 1/2							
13	58 0 0	57 16 3	61 0 0	59 0 0	—	150 5 0	151 16 3	17 2 6	18 10 0	20 0 0	19 3/4	19 3/4	84 11 1/2							
14	56 7 6	55 18 9	60 15 0	—	—	149 3 9	150 18 9	16 10 0	18 5 0	19 15 0	19 1/2	19 1/2	84 11 1/2							
15	55 7 6	55 1 3	60 15 0	—	—	147 12 6	149 7 6	16 7 6	17 17 6	19 10 0	19 1/2	19 1/2	84 11 1/2							
16	54 8 9	54 6 3	60 15 0	59 0 0	—	144 15 0	146 16 3	16 7 6	17 15 0	19 10 0	19 1/2	19 1/2	84 11 1/2							
19	54 0 0	53 16 3	60 15 0	—	—	143 12 6	145 12 6	16 7 6	17 16 3	19 10 0	18 3/4	18 3/4	84 11 1/2							
20	53 18 9	53 16 3	61 0 0	60 0 0	—	141 16 3	143 13 9	16 7 6	17 13 9	19 5 0	18 3/4	18 3/4	84 11 1/2							
21	55 2 6	55 0 0	61 0 0	—	—	143 17 6	145 15 0	16 15 0	17 16 3	19 5 0	18 3/4	18 3/4	84 11 1/2							
22	54 10 0	54 8 9	61 0 0	—	—	142 11 3	144 11 3	16 17 6	17 17 6	19 5 0	18 3/4	18 3/4	84 11 1/2							
23	54 2 6	54 2 6	61 0 0	60 0 0	—	141 1 3	143 1 3	16 17 6	17 18 9	19 10 0	18 3/4	18 3/4	84 11 1/2							
26	54 6 3	54 3 9	61 0 0	—	—	141 18 9	143 18 9	16 15 0	18 2 6	19 10 0	18 3/4	18 3/4	84 11 1/2							
27	53 18 9	53 18 9	61 0 0	60 0 0	—	143 6 3	145 6 3	16 18 9	18 0 0	19 10 0	18 3/4	18 3/4	84 11 1/2							
28	53 16 3	53 16 3	61 0 0	—	—	141 3 9	143 2 6	16 16 3	18 0 0	19 10 0	18 3/4	18 3/4	84 11 1/2							
29	53 18 9	54 1 3	61 0 0	—	—	141 3 9	143 3 9	16 16 3	18 0 0	19 10 0	17 3/4	17 3/4	84 11 1/2							
30	54 1 3	54 1 3	61 0 0	60 0 0	—	140 13 9	142 13 9	16 15 0	18 0 0	19 10 0	17 3/4	17 3/4	84 11 1/2							
June																				
2	53 16 3	53 16 3	61 0 0	—	—	138 16 3	140 13 9	16 12 6	17 15 0	19 5 0	17 3/4	17 3/4	84 11 1/2							
3	53 6 3	53 11 3	61 0 0	59 15 0	—	136 18 9	138 16 3	16 8 9	17 18 9	19 10 0	16 3/4	16 3/4	84 11 1/2							
4	52 18 9	53 6 3	61 0 0	—	—	135 2 6	136 18 9	16 7 6	17 17 6	19 10 0	15 3/4	15 3/4	84 11 1/2							
5	52 16 3	53 1 3	61 0 0	—	—	137 11 3	139 11 3	16 15 0	17 18 9	19 10 0	15 3/4	15 3/4	84 11 1/2							
6	52 6 3	52 11 3	61 0 0	60 0 0	—	139 2 6	141 3 9	16 15 0	18 1 3	19 10 0	16 3/4	16 3/4	84 11 1/2							
9	—	—	—	—	—	—	—	—	—	—	—	—	—							
10	51 7 6	51 11 3	61 0 0	59 10 0	—	137 13 9	139 13 9	16 11 3	18 0 0	19 10 0	16 3/4	16 3/4	84 11 1/2							

months of the year and with more metal offering from America, prices have eased a little, the value at the beginning of June being about 3s. 8d. to 3s. 9d. per lb.

COBALT METAL.—The official price is still 10s. per lb.

COBALT OXIDES.—A moderate business continues at the unaltered quotations of 8s. per lb. for black and 8s. 10d. for grey.

CHROMIUM.—Around 2s. 6d. per lb. represents the current value, demand being fairly good.

TANTALUM.—Only very limited quantities are changing hands, and quotations vary between £40 and £50 per lb.

PLATINUM.—Leading producers have arrived at a tentative agreement regarding prices, which are steady at £8 10s. to £8 15s. per oz. for refined metal.

PALLADIUM.—Very little interest has been displayed in this metal and quotations are easier on the month at about £4 10s. to £5 per oz.

IRIDIUM.—The recent weakness of this market has led to concerted action on the part of the principal sellers and prices have been advanced sharply to £41 10s. per oz. for sponge and powder.

OSMIUM.—Quite a good demand has been seen, and quotations are firmer at £14 5s. to £15 per oz.

TELLURIUM.—Quotations are wholly nominal in the absence of business at about 12s. 6d. to 15s. per lb.

SELENIUM.—Prices keep very steady at 7s. 8d. to 7s. 9d. per lb. ex warehouse Liverpool, the volume of demand remaining fairly good.

MANGANESE ORE.—Business has been at a standstill during recent weeks, no interest being shown by users, who are very well covered by current contracts. Sellers ask around 1s. 1 1/2d. per unit c.i.f. for best Indian ore and 1s. 0 1/2d. to 1s. 1d. c.i.f. for washed Caucasian.

ALUMINIUM.—This market has been somewhat featureless in the absence of any appreciable demand, and prices are unchanged at £95, less 2%, delivered, for ingots and bars. It is interesting to note, however, that serious attention is being devoted to

the establishment of a local producing industry in Japan.

SULPHATE OF COPPER.—A quiet business has been passing at around £24 10s. to £25 per ton, less 5%, for English.

NICKEL.—Leading interests continue to quote £170 to £175 per ton.

CHROME ORE.—Demand has not been particularly brisk, but sellers are firmly maintaining prices at £4 2s. 6d. to £4 7s. 6d. per ton c.i.f. for good average 48% ore.

QUICKSILVER.—Until quite recently the market wore a very depressed appearance, but latterly stocks here have declined and with first hands quite firm in their ideas quotations have improved to about £22 15s. to £23 per bottle ex warehouse, full terms, for spot materials.

TUNGSTEN ORE.—There has been an almost entire absence of interest on the part of buyers, and the drop in silver has tended to aggravate the downward tendency of prices. There are now sellers of forward shipment from China at about 22s. per unit c.i.f., with buyers somewhere about 21s. 6d.

MOLYBDENUM.—Quotations are none too clearly defined, buyers being very lukewarm. Values are in the neighbourhood of 32s. 6d. to 35s. per unit c.i.f. for 80 to 85% concentrates.

GRAPHITE.—A moderate enquiry is reported for Madagascar 85 to 90% raw flake at around £25 to £27 per ton c.i.f., but Ceylon lumps are rather neglected at about £24 to £25 c.i.f.

SILVER.—The silver market during May became almost completely demoralized. On May 1 spot bars stood at 19 1/2d. and although during the early part of the month quotations only lost a little ground due to absence of interest on the part of buyers, during the latter half, heavy selling pressure from China, coupled with selling from America, the Continent and to a lesser extent India as well, forced prices down to a fresh low record of 17 3/4d. at which level spot bars closed on May 31. Even at this figure, however, the market wore anything but a hopeful appearance.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	RAND.		ELSE-WHERE.	TOTAL.
	Oz.	Oz.	Oz.	Oz.
May, 1929	858,991	38,607	897,598	
June	821,352	34,677	956,029	
July	853,370	36,110	889,480	
August	850,952	38,649	889,601	
September	814,707	34,846	849,553	
October	853,609	35,081	888,690	
November	827,952	33,641	861,593	
December	813,574	37,560	851,134	
January, 1930.	848,245	34,556	882,801	
February	783,086	35,102	818,188	
March	852,089	37,281	889,370	
April	831,996	36,610	868,606	
May	876,839	39,320	916,218	

TRANSVAAL GOLD OUTPUTS.

	APRIL.		MAY.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	84,500	£134,034	86,000	£140,955
City Deep	93,000	25,063	102,000	26,534
Cons. Main Reef	56,500	20,483	61,000	22,061
Crown Mines	229,000	74,349	250,000	78,932
D'rb'n Roodepoort Deep	40,200	13,638	41,500	14,406
East Rand P.M.	145,500	39,795	155,500	42,644
Geduld	82,500	26,224	86,000	27,290
Geldenhuys Deep	64,500	15,303	70,800	16,031
Glynn's Lydenburg	6,300	2,196	6,800	2,145
Government G.M. Areas	194,000	£377,065	212,000	£405,541
Kleinfontein	52,000	11,397	52,400	11,168
Langlaagte Estate	77,000	£114,957	82,000	£118,644
Luipaard's Vlei	26,300	6,425	28,300	7,118
Meyer and Charlton	17,200	£19,816	17,700	£19,656
Modderfontein New.	149,000	71,173	160,000	74,317
Modderfontein B	67,500	24,012	71,500	24,405
Modderfontein Deep	42,800	22,354	45,900	23,934
Modderfontein East	66,500	19,496	69,500	20,259
New State Areas	75,000	£151,991	79,000	£158,560
Nourse	59,500	18,668	62,400	18,179
Randfontein	195,000	£214,305	226,000	£235,252
Robinson Deep	137,000	35,859	146,000	37,474
Rose Deep	57,000	12,468	62,000	13,457
Simmer and Jack	73,300	20,785	78,500	21,116
Springs	66,000	£189,273	72,500	£150,552
Sub Nigel	28,700	23,680	29,900	25,234
Transvaal G.M. Estates	14,450	4,325	15,434	4,955
Van Ryn	40,500	£40,791	67,000	£107,276
Van Ryn Deep	64,900	£102,855	42,000	£42,479
West Rand Consolidated	88,500	£99,461	92,000	£104,889
West Springs	65,000	£75,102	69,500	£79,929
Witwaters'nd (Knights)	53,000	£50,780	57,000	£54,607
Witwatersrand Deep	38,000	11,347	43,500	13,457

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.	s. d.	
March, 1929.	2,581,600	28 3	20 0	8 3	1,062,331	£	
April	2,606,420	28 1	19 11	8 2	1,068,103		
May	2,694,610	28 0	19 10	8 2	1,100,461		
June	2,543,550	28 3	19 10	8 5	1,065,191		
July	2,649,560	28 1	19 9	8 4	1,112,246		
August	2,661,800	28 1	19 8	8 4	1,113,834		
September	2,530,370	28 2	19 10	8 4	1,056,839		
October	2,658,100	28 1	19 8	8 5	1,115,744		
November	2,559,450	28 3	19 11	8 4	1,071,199		
December	2,528,000	28 3	19 11	8 4	1,058,231		
January, 1930	2,618,600	28 2	19 9	8 5	1,103,718		
February	2,421,100	28 5	20 0	8 5	1,019,482		
March	2,663,820	28 1	19 8	8 5	1,121,216		
April					1,084,504		

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	GOLD MINES.	COAL MINES.	DIAMOND MINES.	TOTAL.
May 31, 1929	195,733	15,852	5,473	217,058
June 30	192,595	15,928	5,029	213,552
July 31	190,031	15,914	4,845	210,790
August 31	190,062	15,867	5,071	211,000
September 30	190,567	15,733	4,814	211,114
October 31	189,739	15,533	4,555	209,827
November 30	186,941	15,320	4,561	206,822
December 31	184,280	15,326	4,811	204,417
January 31, 1930	190,663	15,288	5,889	211,840
February 28	196,752	15,495	6,584	218,831
March 31	200,134	15,350	7,002	222,386
April 30	202,434	15,109	5,565	223,108
May, 31	202,182	15,028	5,340	222,550

PRODUCTION OF GOLD IN RHODESIA.

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

RHODESIAN GOLD OUTPUTS.

	APRIL.		MAY.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	24,000	11,078	24,000	11,055
Globe and Phoenix	6,008	5,748	6,062	5,451
Lonely Reef	5,600	3,903	6,000	3,831
Luri Gold	1,427	£3,364	—	—
Rezende	6,400	2,714	6,400	2,712
Sherwood Star	5,000	£12,476	5,000	£13,980
Wanderer Consolidated	15,000	3,854	15,800	4,075

WEST AFRICAN GOLD OUTPUTS.

	APRIL.		MAY.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	7,322	£13,009	—	—
Ashanti Goldfields	10,648	12,162	10,555	12,251
Taqaah and Abosso	9,400	£15,872	9,600	£15,922

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.		Victoria.		Queensland.	
	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.
May, 1929	28,026	3,018	493	—	—	—
June	33,139	2,368	465	—	—	—
July	28,086	1,421	1,203	—	—	—
August	37,032	2,178	567	—	—	—
September	32,751	1,739	381	—	—	—
October	35,445	—	789	—	—	—
November	28,460	—	473	—	—	—
December	33,650	1,459	1,636	—	—	—
January, 1930	25,472	952	209	—	—	—
February	31,307	1,354	350	—	—	—
March	27,946	—	382	—	—	—
April	36,652	—	—	—	—	—
May	32,967	—	—	—	—	—

AUSTRALASIAN GOLD OUTPUTS.

	APRIL.		MAY.	
	Tons	Value £	Tons	Value £
Associated G.M. (W.A.)	5,282	7,301	5,358	8,538
Blackwater (N.Z.)	3,100	5,596	4,000	7,158
Boulder Perseve'ce (W.A.)	6,501	15,604	7,029	16,857
Grt. Boulder Pro. (W.A.)	9,232	24,160	9,176	24,029
Lake View & Star (W.A.)	6,157	21,238	—	—
Sons of Gwalia (W.A.)	13,462	12,939	13,522	13,934
South Kalgurli (W.A.)	8,360	14,350	8,574	15,555
Waihi (N.Z.)	15,086†	£28,700†	—	—

* Oz. gold.

† Oz. silver.

‡ To May 3.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	APRIL.*		MAY.	
	Tons Ore	Total Oz.	Tons Ore	Total Oz.
Balaghat	—	—	4,150	1,954
Champion Reef	—	—	8,900	5,834
Mysore	—	—	17,239	8,387
Nundydroog	—	—	12,011	7,508
Coregum	—	—	13,500	6,036

* Strike at the mines.

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	APRIL.		MAY.	
	Tons	Value £	Tons	Value £
Chosen Corp. (Korea) ...	9,440	12,340	—	—
Frontino & Bolivia (C'bia)	2,110	7,857	2,500	8,250
Lena (Siberia)	—	4,200	—	—
Lydenburg Plat. (Trans.)	3,350	614 <i>p</i>	3,650	778 <i>p</i>
Marmajito (Colombia) ...	900	8,043	920	5,739
Fresnillo	84,588	55,293 <i>d</i>	—	—
Onverwacht Platinum ...	2,862	286 <i>p</i>	3,050	376 <i>p</i>
Oriental Cons. (Korea) ...	19,320	97,560 <i>d</i>	—	91,500 <i>d</i>
St. John del Rey (Brazil)	—	39,500	—	46,000
Santa Gertrudis (Mexico)	44,257	112,775 <i>d</i>	—	—

d Dollars. *p* Oz. platinum.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

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

July, 1929	5,802	January, 1930	6,128
August	5,610	February	4,768
September	5,332	March	5,763
October	5,966	April	5,407
November	6,135	May	6,043
December	5,849	June	—

OUTPUTS OF MALAYAN TIN COMPANIES.

IN LONG TONS OF CONCENTRATE.

	Mar.	April	May.
Ayer Hitam	83½	101½	95½
Batu Caves	24	29	27
Changkat	17	50	63
Chenderiang	26	29	42
Gopeng	62½	62½	62½
Hongkong Tin	83½	89½	51
Idris Hydraulic	26½	29½	29½
Ipo	17½	40½	38
Jelapang	23	23	31
Kamper Malaya	40	83	69
Kampung Lanjut	43	50	90
Kamunting	109	116	106
Kent (F.M.S.)	30	28½	25
Kepong	33	33	36
Kinta	20	21	24
Kinta Kellas	29½	18	29½
Kuala Kampar	62	70	65
Kundang	12	29	22
Labat	14½	15½	15½
Larut Tinfields	34½	45½	36
Malaya Consolidated	66	42	72½
Malayan Tin	113	119	119
Meru	18	24	13½
Pahang	226	225	225
Penawat	65½	42	85½
Pengkalen	45	48	45
Petaling	190	178½	173
Rahman	594	56½	71½
Rambutan	9½	9	9
Rantau	28	46	48
Rawang	90	90	90
Rawang Concessions	30	30	45
Renong	40½	50½	108
Selayang	24	24	23
Southern Malayan	160½	154½	154½
Southern Perak	80½	89½	98½
Southern Tronoh	50	60	31
Sungei Besi	45	45	45
Sungei Kinta	18½	41	12½
Sungei Way	77½	77½	88½
Taiping	19	36	48
Tanjong	33	30	27
Teja Malaya	10½	43	45½
Tekka	48	42	36
Tekka Taiping	36	51	57
Temoh	36½	41½	51
Tronoh	71	72	69

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.
IN LONG TONS OF CONCENTRATE.

	Mar.	April	May.
Amari	5	6	—
Anglo-Nigerian	84	83½	94
Associated Tin Mines	200	200	200
Baba River	5	12	16½
Batura Monguna	2	1½	1½
Bisichi	95	65	65
Daffo	3	—	—
Ex-Lands	56	50	—
Filani	1½	2½	2½
Jantar	35	26	—
Jos	22½	17½	—
Juga Valley	16	16	20
Junction	6	5	6
Kaduna	25½	37	—
Kaduna Prospectors	21½	23	—
Kassa	13½	15½	27
London Tin	220	220	220
Lower Bisichi	5½	4½	—
Naraguta	20	26½	—
Naraguta Durumi	13½	16½	—
Naraguta Extended	4	—	8
Naraguta Karama	17½	23	—
Naraguta Korot	10	9	—
Nigerian Consolidated	18	18	18
Offin River	7	8	8
Ribon Valley	16½	21½	—
South Bukuru Areas	10	13	10
Tin Fields	4½	6½	—
Tin Properties	9	17	13
United Tin Areas	21	21	23
Yarde Kerri	10	10	—

OUTPUTS OF OTHER TIN MINING COMPANIES.
IN LONG TONS OF CONCENTRATE.

	Mar.	April.	May.
Anglo-Burma (Burma)	13½	12½	—
Aramayo Mines (Bolivia)	183	273	205
Bangrin (Siam)	61½	48½	53½
Berenguela (Bolivia)	—	—	—
Consolidated Tin Mines (Burma)	100	94	77
East Pool (Cornwall)	82½	82½	112½
Fabulosa (Bolivia)	147	158	112½
Geevor (Cornwall)	75	65	60
Jantar (Cornwall)	31	28½	—
Kagera (Uganda)	28	28	28
Northern Tavoy	30	54	45
Patino	—	1,602	—
Polhigey (Cornwall)	32	26	23½
San Finx (Spain)	16½*	80½*	146½
Siamese Tin (Siam)	153	122½	64½
South Crofty (Cornwall)	65	62½	64½
Tavoy Tin (Burma)	20	20	20
Theindaw (Burma)	6	10	10
Tongkah Harbour (Siam)	60	62	67
Toyo (Japan)	—	—	—
Wheal Kitty (Cornwall)	40	38½	40
Zaaiplaats	30	—	—

* Tin and Wolfram.

COPPER, LEAD, AND ZINC OUTPUTS.

	April.	May.
Broken Hill South	{ Tons lead conc. ... 5,058	5,188
	{ Tons zinc conc. ... 4,318	4,775
Burma Corporation	{ Tons refined lead. 6,420	6,420
	{ Oz. refined silver 610,561	607,645
Bwana M'Kubwa	Tons copper oxide	587
Electrolytic Zinc	Tons zinc	4,279
Indian Copper	Tons copper	220
Messina	Tons copper	515
Mount Lyell	Tons concentrates	3,119½
Namaqua	Tons copper	171
North Broken Hill	{ Tons lead conc. ... 7,030	—
	{ Tons zinc conc. ... 5,950	—
Poderosa	Tons copper ore	843
Rhodesia Broken Hill	{ Tons lead	—
	{ Tons slab zinc	1,605
San Francisco Mexico	{ Tons lead conc. ... 3,669	4,050
	{ Tons zinc conc. ... 3,460	3,639
Sulphide Corporation	{ Tons lead conc. ... 1,775½	1,912*
	{ Tons zinc conc. ... 2,318½	2,467*
Tetiuhc	{ Tons lead conc. ... 1,162	1,129
	{ Tons zinc conc. ... 2,522	2,330
Union Minière	Tons copper	—
Zinc Corporation	{ Tons lead conc. ... 4,922½	5,034
	{ Tons zinc conc. ... 4,113½	4,327

† Four weeks to May 3.

‡ Four weeks to April 23.

§ Four weeks to April 19.

* Four weeks to May 17.

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

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

FAN EFFICIENCY

The *Journal* of the Chemical, Metallurgical and Mining Society of South Africa for March contains a paper by Mr. R. A. H. Flugge-de Smidt on the computation of fan efficiency, of which full extracts are given here.

The author states that when a mine fan is required the ventilating engineer should stipulate not only the quantity of air to be circulated but also the drop in pressure between intake and outlet that should occur when the stated quantity is forced through the mine. When the fan is installed and running, the quantity and drop in pressure are measured, and the figures should decide whether the contract between fan-maker and fan-user has been fulfilled.

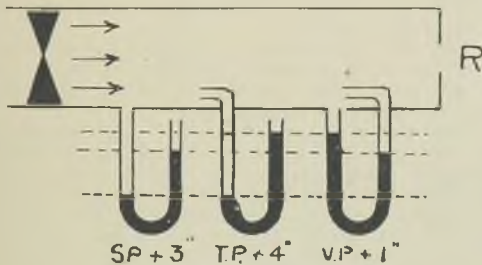


FIG. 1.

Quantities can be measured with a fair degree of accuracy, so can pressures, provided it is agreed upon which pressure is to be measured. A definite nomenclature for the various pressures that are measured is that of the National Physical Laboratory at Teddington and the terms Static Pressure, Velocity Pressure and Total Pressure may well be accepted.

Static Pressure is the pressure exerted against the wall of a duct and is measured in the simplest way with one leg of a U-tube flush with the inside wall of the duct. Total Pressure is not so easy to define. It is measured with one leg of a U-tube bent to face the current. Velocity Pressure is the pressure required to produce a given velocity. It is always the difference between Static and Total Pressures. It can be measured with one limb flush and the other facing the current.

Because these various pressures are measured from the datum-line of atmospheric pressure it is necessary to differentiate between forced and exhaust draught. A forcing fan builds up a pressure that is greater than atmospheric pressure. All pressures measured therefore have a positive value. In Fig. 1, $T.P. (+ 4") = S.P. (+ 3") + V.P. (+ 1")$. The fan produces both the static pressure and the velocity pressure.

It is agreed that the fan must be accredited with the total pressure and the efficiency of the fan would be based on the pressure reading of + 4",

i.e., the pressure as measured by a "Facing" head. As the velocity is not uniform over the cross-sectional area of any duct, the total pressure is also a variable and so the average total pressure must be ascertained. The velocity pressure may be utilized to advantage by being converted into static pressure so to perform useful work. The fan-maker cannot be debited with the loss of energy that occurs when the air issues from the outlet of the mine at a high velocity.

With an exhaust or suction fan both static and total pressures are less than atmospheric pressure. Velocity pressure is always positive. Using the same tubes as before in Fig. 2, $T.P. (- 3") = S.P. (- 4") + V.P. (+ 1")$. In this case although the total pressure is numerically smaller than static pressure, it still represents the algebraic sum of static and velocity pressures. Surveyors when measuring levels, work from an arbitrary datum-line, which is either above or below all possible measurements. They do so in order to avoid any confusion as to + and - signs. A similar datum-line for air-pressures equivalent to a pressure of - 20" W.G. might be selected. Then the equation:

$$T.P. - 3" = S.P. (- 4") + V.P. (+ 1")$$

becomes:—

$$T.P. (+ 17") = S.P. (+ 16") + V.P. (+ 1").$$

If measured from absolute zero the position would be the same, i.e., T.P. would always be numerically greater than S.P.

It is easy to say that the efficiency of the fan must be based in the above case on the total pressure of - 3" and not on the, for the fan, more advantageous figure of - 4", i.e., the static pressure. To prove it to those who have long been in the habit of basing efficiencies on static pressure is not an easy matter. For the sake of simplicity it may be assumed that the fan is discharging through an aperture which is of the same dimension as the fan-drift on the suction side; as would be the case with a propeller fan without an evasee.

In Fig. 3 R. represents the mine. The only useful work that the fan does as far as the mine is concerned is to produce the total Pressure A. The static pressure C. includes the velocity pressure in

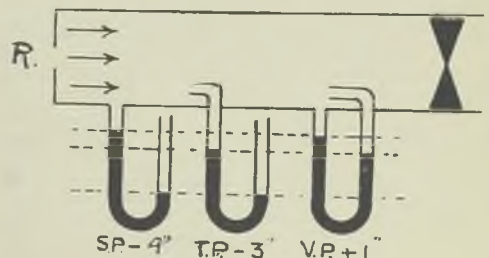


FIG. 2.

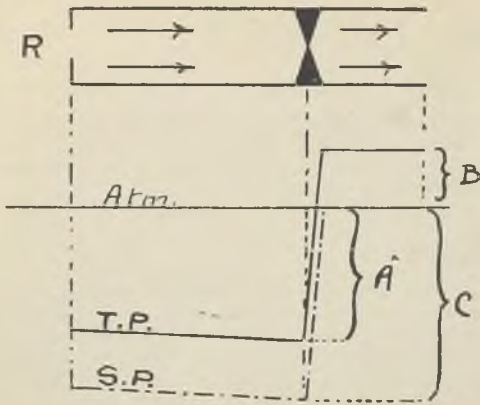


FIG. 3.

the fan-drift, $C = A + B$. The velocity pressure of the air in the fan drift is in this case equal to the energy of the air discharged to atmosphere and is all waste energy. Granted the fan produces it ; but fan makers cannot be allowed to credit this energy to the efficiency of the fan as far as the mine is concerned. The effect of clapping on an evasee to the system may possibly make the point a little clearer. The idea of an evasee is to reduce the velocity of the air discharged to atmosphere to a minimum, that is, to reduce the waste energy to a negligible quantity as at D in Fig. 4. By adding an evasee to the system more air is pulled through, that is, velocities as well as pressures are increased. In order to make a more direct comparison with the case depicted in Fig. 3, it may be assumed that the volume passing is kept a constant by increasing the resistance R. All the effect created by the evasee is then concentrated on an increase of pressure only so that both the total and the static pressure in the fan-drift are increased according to the efficiency of the evasee. The greater portion of the velocity pressure energy has been converted to useful energy and is now included in the increased figure obtained for total pressure in the fan drift. Is it reasonable to include the velocity pressure in the fan drift twice as would be the case if one measured the static pressure C. ?

It is interesting to note that the effect of the evasee is to cause a negative static pressure at the base of the evasee. This point has been most clearly demonstrated by G. E. McElroy and A. S. Richardson in a pamphlet published by the U.S. Bureau of Mines, entitled "Experiments on Mine-Fan Performance". Theoretical considerations are often far from convincing. A practical example of a large scale experiment conducted by Messrs. McElroy and Richardson may be examined.

Fig. 5 is a reproduction of Fig. 17 of their pamphlet. Total pressures show up as a progressive increase towards the intake. Static pressures particularly in test No. 39 fluctuate to an extraordinary degree. A fan-maker, who uses static pressure readings, would place his gauge approximately in the same plane of pressure measurement as selected by McElroy and Richardson and measure 5.15" W.G. instead of 2.71" W.G. The effect of a right-angled bend at the fan inlet is most striking and confirms what the author endeavoured to point out as far back as May, 1925, when exhibiting a model of an ideal inlet to a centrifugal fan.

To take McElroy and Richardson's figures. The drop in pressure or loss incurred through a right-angled bend at the fan inlet is $4.30 - 3.57 = 0.73$ " W.G. The velocity pressure is $4.06 - 3.57 = 0.49$ " W.G. The loss is therefore nearly 150% of the velocity pressure.

Test No. 15 shows the same relative loss.

If the simple explanation that has just been given is not convincing, references to other authorities may strengthen the argument.

Prof. Henry Briggs in his book "The Ventilation of Mines", has given a simple mathematical solution. He proves that the total pressure should be used when evaluating the "horsepower in the air," which after all is the useful work done by the fan. The difference between the energy of the air inside the fan drift and the energy of the air in the outside atmosphere is the gain in energy and this he proves mathematically to be equal to what has been termed total pressure multiplied by the volume in cubic feet. On page 112 Briggs says : "It has been, and largely still is, the custom of fan makers to use the static gauge reading in ascertaining fan efficiency. Considerable credit devolves upon Messrs. Keith, Blackman & Co. for

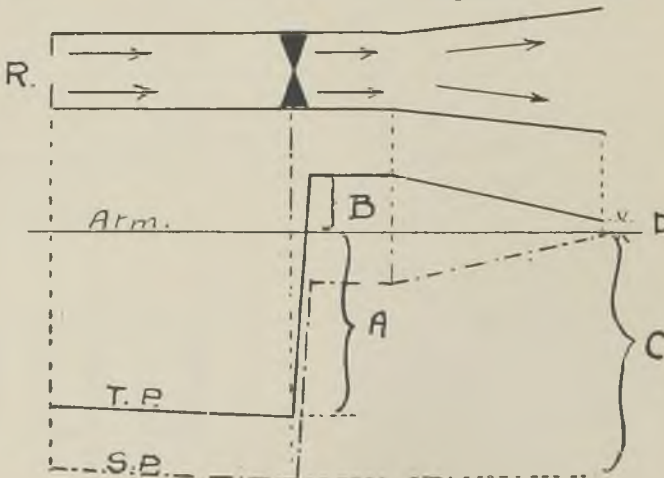


FIG. 4.

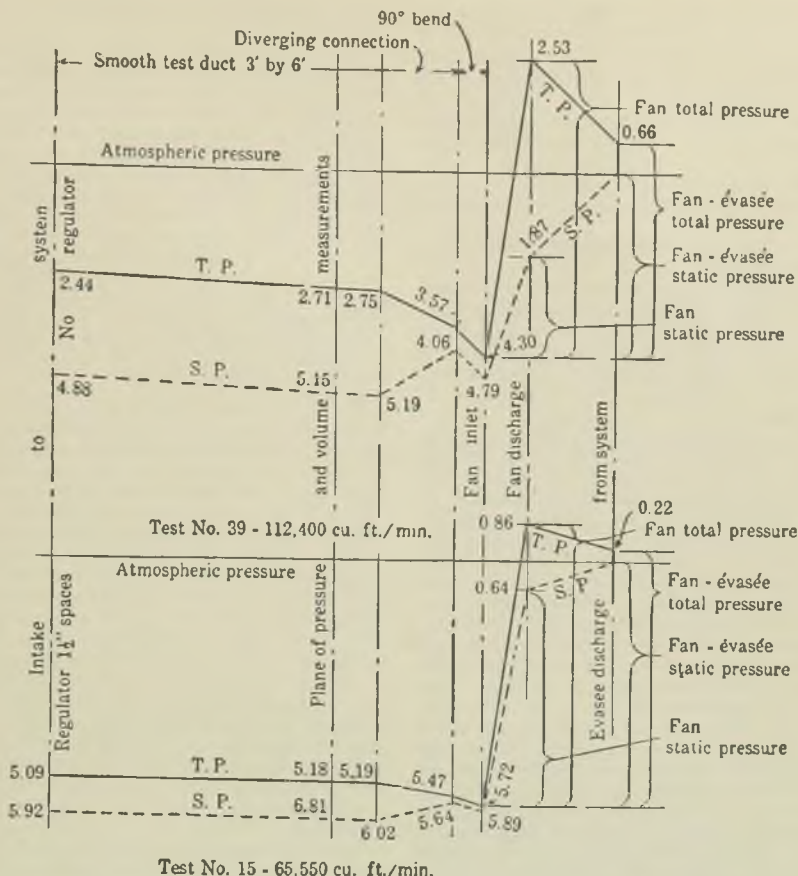


FIGURE 17.—Graphical analysis of pressure changes through test installation and fan for two tests of large single-inlet narrow width suction mine fan equipped with évaseé discharge

FIG. 5.

being the first among makers in Great Britain to point out the error thus introduced and to insist upon the total gauge being employed. The result of using the static gauge is to obtain efficiencies which are too high for exhausting fans and too low for forcing fans." Prof. Briggs' nomenclature is identical to that just described.

In 1926 a fan-maker on the Continent pointed out to the author the absurdity of using static pressure as a basis for calculating the efficiency of an exhaust fan. He cited a case where the efficiency worked out at over 100% by so doing. To appreciate this point one must know that this particular fan-maker built fans showing an efficiency of 83% on the total pressure basis.

McElroy and Richardson, in the pamphlet to which reference has been made, show how futile it is to base calculations on static pressure measurements; but in calculating fan efficiencies go too far again by adding the velocity at the base of the evasee to the total pressure obtained in the fan-drift. Had they added the velocity pressure of the discharge of the evasee it would have been logical; but as it is they accredit the fan with

nearly twice the effect of the velocity pressure. It can be agreed that the measurement they accredit to fan-evasee total pressure is correct.

To sum up the position: The actual work done by the fan should be calculated from the total pressure or facing-head in the fan-drift + the velocity pressure of the air discharged to atmosphere. As it is possible by constructing a suitable evasee to reduce the latter factor to a negligible quantity it is reasonable to confine attention to what is useful work only, as far as the mine is concerned, i.e. the total pressure in the fan-drift. By basing all figures for fan efficiencies on this figure only, fan-makers are compelled in their interests and in those of the users to construct efficient evasees.

The case of a fan situated underground, i.e., acting both as an exhaust and a forcing fan has not been touched upon. It follows logically, however, from the foregoing that a U-tube with one leg attached to a facing-head on the intake side and the other to a facing head on the delivery side will give the correct total pressure for a fan in that position.

THE PRESERVATION OF MINE TIMBERS

In the *Canadian Mining and Metallurgical Bulletin* for May J. F. Harkom discusses the preservative treatment of mine timbers. He suggests that mine timbers may be divided into three classes when considering preservative treatments:—

1. Timber obviously not profitable to treat owing to long natural life or short period of time in service.

2. Timber that obviously should receive protection from decay.

3. Timber installed in locations where the length of service required will depend on future developments, so that preservative treatments might or might not prove to be a profitable investment.

Provided that timber obviously not requiring treatment is not included, money will rarely be lost by treating.

The decay of wood is due to the action of fungi, low forms of plant life which break down and consume the wood substance as food. The preservative treatment of timber is effected by injecting certain substances into the timber which will poison the food supply and thus inhibit the growth of fungi on the wood substance. While timber can be treated green, it is usually more economical to air-season it before treatment. This necessitates careful inspection and supervision from the time the timber is cut until it enters the treating cylinder, in order to ensure that only sound timber, free from decay, is treated. This supervision and inspection cannot be too thorough. The best practice in seasoning timber for treatment is to provide a well-drained seasoning yard at the treating plant and remove all timber from the bush to the plant immediately after cutting. At the treating plant it is possible to supervise the piling and ensure that the most suitable method of stacking is used for each species and dimension of timber, the object being to air-season the timber as rapidly as possible without producing severe checking. The more quickly the moisture content of the outside of the timber is reduced below 20% the lower will be the percentage of timber infected with decay before treatment. When timber is treated with a preservative, any decay, in the interior which is not reached by the treating solution will not be killed or sterilized by the preservative, and growth will continue inside the treated zone; and while the treated portion on the exterior will remain sound, eventually the timber will become a hollow shell.

While the ordinary treating processes used for the treatment of air-seasoned timber do not completely sterilize the timber, it is possible to do so at the expense of prolonging the time of treatment. The interior of the timber not penetrated by the treating solution may be sterilized by heating to a temperature of approximately 150° F. This may be accomplished by steaming at a pressure of 20 lb. per sq. in. or by holding the timber in a bath of hot preservative. The economic benefits of sterilization have not been worked out as yet on a large scale, but will probably be more intensively studied in the future.

The treatment of mine timber in Canada may be conveniently divided into two groups:—

1. Timber treated at commercial treating plants.

2. Timber treated in small treating plants operated by mining companies at or near a mine.

The preservatives available at the commercial treating plants are creosote and zinc chloride. While special arrangements can be made for the treatment of timber with any other specified preservative, this would only be practical when a comparatively large order was involved. The following table indicates the comparative advantages and disadvantages of zinc chloride and creosote:—

	Creosote.	Zinc Chloride
First cost	Greater	—
Annual cost:		
Over 15 years' service	Lower	—
Under „ „ „	—	Lower
Handling of treated timber	—	Cleaner
Fire risk	—	Lower

If the factors of cost and handling of timber after treatment were eliminated, creosote would probably be used in preference to zinc chloride, assuming that the question of fire risk was eliminated. The fire risk from creosoted timber six months after treatment is generally rather exaggerated.

Zinc chloride will be found quite satisfactory as a preservative. It is comparatively cheap and the timber after treatment is clean to handle. The greatest objection is that it is a water-soluble salt, which will be leached out of the wood in wet localities. This is probably not so serious a factor in mines as experience with zinc chloride above ground would indicate. If the timber is thoroughly sterilized during the treating process, it is probable that treatment with zinc chloride would return the cost of treatment by increasing the service-life even in quite a wet mine. It is, however, a tricky question which can only be answered by experience.

The importance of framing timber prior to treatment cannot be stressed too strongly. If the treated shell on the exterior of the stick is mutilated, and the untreated wood exposed, practically all the benefit of the preservative treatment will be lost.

In the treatment of railway ties, the object of the preservative treatment is to preserve the tie from decay until it breaks up from mechanical wear; so, in the treatment of mine timber, the object should be to prevent decay for the number of years it is estimated that the timber will be in use. The advantage of operating a small treating plant at a mine is the ease with which the treating programme can be adopted to the particular local requirements and the opportunity it affords to utilize any preservatives which may be obtained more cheaply than creosote or zinc chloride in that particular locality.

The most simple methods of applying wood preservatives are by brushing or by dipping. Such applications, however, give very erratic results, and, as the thin film of preservative is easily destroyed by scraping or other rough usage, these treatments are not to be recommended for use in mines. This leaves the choice between what are known as hot- and cold-tank treatments, and pressure treatments. In the first process, the timber is immersed in a tank of hot treating solution for from two to eight hours, and then placed in a tank of cold solution for from four to eight hours. Pressure treatments are carried out

in a closed cylinder and the preservative is forced in under pressure. With the exception of hemlock and spruce, the sapwood of practically all species of timber is more readily impregnated with preservatives than heartwood. Therefore, if round props are to be treated, a hot- and cold-tank treating plant will serve the purpose. If, however, sawn heartwood timber is to be treated, a pressure treatment is advisable. Also, as pressure treatments can be carried out in about one-third the time required for the hot- and cold-tank process, a pressure treating plant is more economical for handling large quantities of timber.

The cost of treating timber varies considerably, and depends on the care taken in drawing up the treating programme and on the layout of the treating plant. The normal routing and handling of material through a treating plant will be as follows:—

1. Unloading incoming green timber and stacking in seasoning yard.
2. Transporting seasoned timber to the treating tanks or cylinders.
3. Charging tanks or cylinders.
4. Unloading tanks or cylinders.
5. Disposal of treated material either directly to the mine or to storage piles.

For unloading incoming timber, barking, and stacking in the seasoning yard, manual labour is the most economical, as it is also for loading on to the tram or other conveyance used to carry the timber to the treating cylinder. After the timber is loaded for conveyance to the treating tank or cylinder, manual labour should be dispensed with as far as possible. After treatment, timber need not be carefully stacked, as is required for air seasoning, and it may be handled by crane or derrick and dropped in close piles until required for use.

The steps necessary for the economical production of treated timber in a small plant may be summarized as follows:—

1. Selection of the preservative and treating process that will be most economical for the length of life required from the timber.
2. Economical handling of timber.
3. Minimum capital cost of treating plant.
4. Operation of plant as far as possible by part-time men who can also carry out other duties.

In estimating the average life of treated timber, the following figures may be safely used:—

	Hot- and Cold-Tank Treatment with Zinc Chloride.	Pressure Treatment with Zinc Chloride.	Pressure Treatment with Creosote.
	Years.	Years.	Years.
Life untreated .	2	5	5
Life treated .	6 to 10	15	20 to 25

Following are a few illustrations to indicate how to determine the amount of money which can be profitably invested in a small treating plant. These are worked out by determining how much money can be spent for preservative treatments so that the annual charge for the treated timber will be the same as the annual charge for untreated. The annual charge may be said to be equal to simple interest on the cost of the material in place, plus an amount which, if set aside annually at compound interest, would provide a fund for the replacement cost at the end of the service period.

Example I.—A mine uses per year 1,000 pit props having a life, untreated, of two years. How much can be spent for an open-tank treating plant using zinc chloride on the assumption that the average life will be increased to six years?

Volume of prop	3 cu. ft.
Purchase price	\$0.50
Cost of erection	0.50
Cost in place	\$1.00

In this case, \$1.68 can be spent for treatment without increasing the annual cost, the rate of interest being 6%.

Cost of preservative, per prop (½ lb. of dry salt per cu. ft. at 10 cents per lb.)	\$0.15
Cost of handling, labour	0.06
Cost of operating treating plant, labour	0.12
Total per prop	\$0.33

Available for interest and depreciation on plant, per prop $\$1.68 - 0.33 = \1.35

Therefore, for 1,000 props per year, there will be available $1,000 \times \$1.35 = \$1,350.00$ for interest and depreciation on the treating plant. As an open tank plant of this size can be built for less than \$1,000, it will pay for itself the first year and may afterwards be operated at a profit of approximately \$1,300 per year. There is also an additional saving which is not included in the above estimate, that is, the labour cost of replacing the untreated props every two years as against every six years for treated props.

Example II.—A mine uses per year 5,000 props having a life, untreated, of 5 years. How much can be spent for a small pressure treating plant using zinc chloride, assuming that the average life will be increased to 16 years?

As before, the cost of the treated prop in place is \$1.00. In this case \$1.39 can be spent for treatment without increasing the annual cost, the rate of interest being 6%.

Preservative per prop	\$0.15
Handling, labour, per prop	0.06
Operating treating plant, labour, per prop	0.12
Total per prop	\$0.33

Available for interest and depreciation on plant, per prop $\$1.39 - 0.33 = \1.06
 For 5,000 props $\$1.06 \times 5,000 = \$5,300$

As a small pressure treating plant of this capacity could be installed for from \$10,000 to \$15,000, the plant would be paid for in from two to three years and afterwards be operated at a profit of approximately \$5,000 per year. The orthodox method for large and small plants is to place the treating cylinders horizontally. The cylinders used at commercial treating plants in Canada are 7 ft. in diameter and from 140 to 160 ft. long. The seasoning yards are served by standard-gauge tracks for the incoming green timber, and by narrow-gauge tracks leading to the treating cylinders. The timber to be treated is loaded on small trams which are run into the treating cylinder. For small plants using a short cylinder there is a possibility that mounting the cylinder in a vertical position, so that the timber could be handled by derricks, would result in more economical operation.

DEPTH CHARTS

At a meeting of the Malayan Tin Dredging, Mining and Research Association held on January 29 last, Mr. James M. Macintyre, of Malayan Tin Dredging, Ltd., read a paper on depth charts, and full extracts of this paper are given here.

Now that the richest dredging ground in Malaya is being or has been worked, the time is approaching when dredging companies will be dependent on big yardages to make reasonable profits. Since yardage is such an important factor in dredging work, it is necessary to know immediately a dredge is slowing up and to rectify the trouble as soon as possible.

The depth chart gives the length and depth of a face in elevation, the width being marked up in feet. It is by the chart that the dredgemaster can compare the working of the different shifts. The charts are handed in at the office daily and statements are made out every eight days, showing the yardage and running time of each dredge during that period, and the causes of low yardage are immediately investigated.

Absolute accuracy in depth charts is quite impossible and all persons engaged in dredging must have wondered why it is that the chart seems generally to return a lower figure than actual working suggests. In addition the figures obtained by the addition of all the charts generally do not correspond with those made out by the surveyor. The author has endeavoured to point out a few conditions met with in ordinary dredging which may partly account for this discrepancy.

Taking width or distance of pull ahead first, as it usually receives least attention, although it is a cause of inaccuracy in chart making.

WIDTH.—A dredge pulls ahead 6 feet at a time, this distance having been decided upon as the most suitable in this class of work. Under ideal headline conditions 6 ft. of line are drawn in and marked on the chart. Unfortunately headline conditions are seldom anything like ideal, as most of them foul roots and stumps of trees somewhere in their paths and these snags foul for short or long periods, depending on how far they are placed from the original face.

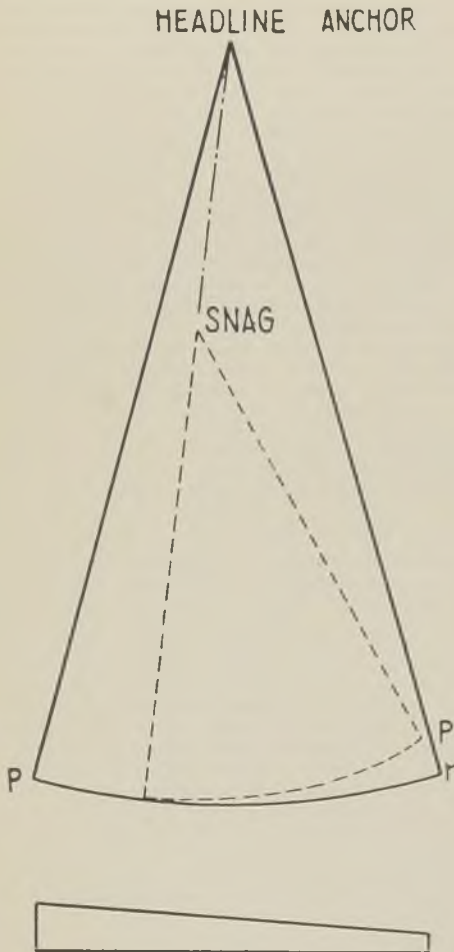
Condition I.—In the case of a dredge working forward with a snagged headline the angle from the headline bracket, on the front of the dredge, becomes gradually greater until the line frees itself, or the root gets cut down. Fig. 1 shows the results of such a happening. The dredge falls back off the face on the right and the buckets come up empty. If the cut pinches out very rapidly the man in charge immediately shortens the length of the cut to where solids end. Each subsequent cut will be slightly longer until the buckets cut right up to the posts marking the limits of the cut. The shape of the cuts on the plan will be tapered at the right during this operation, and it is not true to say the dredge has cut 6 ft. solid all the way. This causes the chart figures to be slightly high.

Condition II.—Headline backers require shifting ahead from time to time and it seldom happens that the dredgemaster finds a suitable spot directly behind the old backer, so that the shape of the face alters (Fig. 2). In this case almost the same thing happens as in the case of the snag. The dredge is pulled up to the face until the dredgemaster is satisfied that 6 ft. of the bank is being cut at the point of first contact. The dirt pinches out at one or both ends of the face. Until the dredge is on a solid face the charts will be inaccurate.

Condition III.—This is the case of a dredge whose tailings are tight behind. If, when pulling ahead when the dredge is tight, it is found necessary to pull in more than the standard 6 ft. in order to cut top material the fact should be made known on the depth chart. Suppose it is necessary to pull in 18 ft. If the headline is in no way snagged and it is perfectly certain that the dredge is being shoved forward the chart should be worked out on an 18 ft. width. This will give an absolutely impossible yardage, but it has got to be done as it will be the first indication to the dredgemaster that the tailings trouble has become serious. Also the surveyor will take this in and if only 6 ft. are marked up the total yardage will be very far out and most probably the ground will have to be dug over again.

It will be agreed that the pull ahead is not quite the simple matter it seems and it largely affects the accuracy of the depth charts.

LENGTH.—All dredgemasters carefully measure the lengths of the various faces regularly and often.



PLAN OF CUT

FIG. 1.

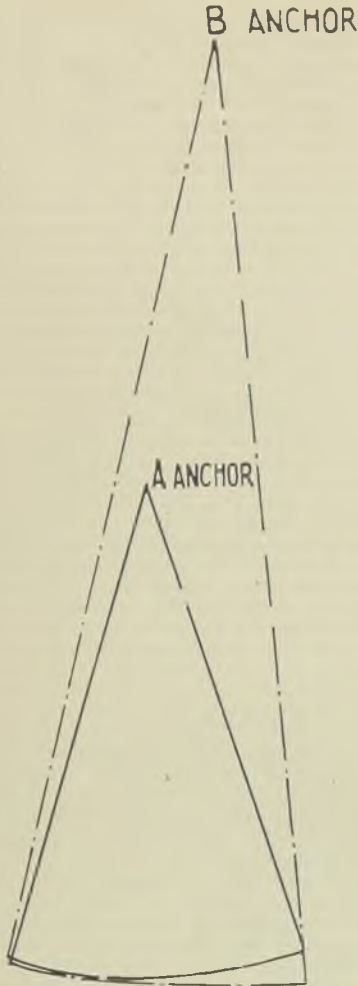


FIG. 2.

This in itself is greatly to be desired but it does not take into consideration the slope or batter of the banks. To measure the simple length of a face can sometimes be a very difficult business. This discussion will not deal with any peculiar cases, but will confine itself to the conditions usually met with in more or less straight-ahead dredging.

Condition I.—In the case of a dredge working on a cut with solid ground all the way and on both sides, where the dredgemaster has his posts out to mark the limits of the face, it will be agreed that the ground is not dug to rock bottom at the corners in a perfectly perpendicular line. This is quite impossible, and should always be allowed for by the surveyor in this way: The surveyor takes 24 ft. as approximately the half width of the dredge and

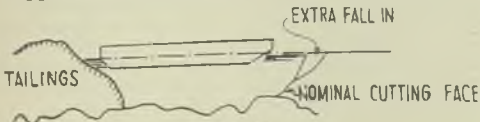


FIG. 3.

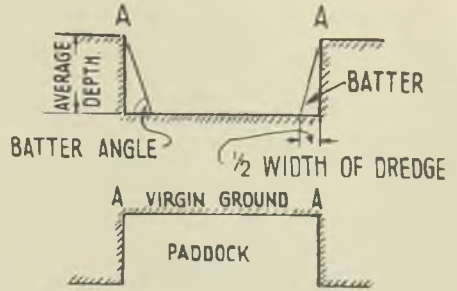


FIG. 4.

uses this to calculate the amount of batter, or ground left behind at the sides of a face. This means that a right angled triangle is the base of his calculations having the side adjacent 24 ft. and the side opposite the average digging depth. Naturally, in shallow ground the batter angle will be small, leaving a greater amount of batter, and in deep ground the angle of batter will be large, leaving a corresponding smaller quantity of ground behind in proportion to the total amount dug. The angle is

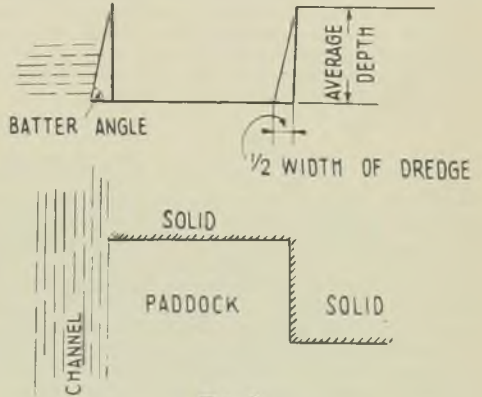


FIG. 5.

45° in all cases where tailings are being dug, irrespective of the depth. This of course is merely an arbitrary figure and a matter of arrangement between the manager and his surveyor. Unless the dredgemaster allows the same figure he will be out in his charts and the narrower his area cut in a month the greater will be the total error (Fig. 4).

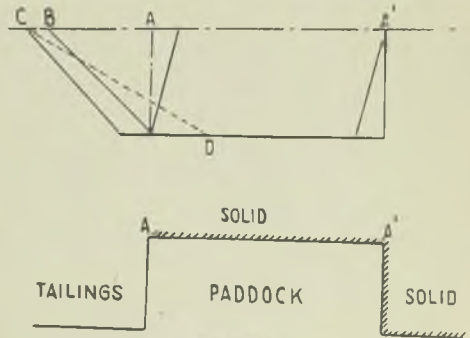


FIG. 6.

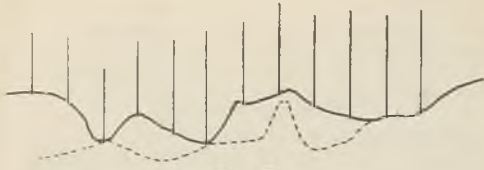


FIG. 7.

Condition II.—In Condition II one side of the face has a deep channel, possibly left over by the same dredge after previous working. The dredgemaster will insist on cleaning up the bottom to the toe of the solids (Fig. 5). Here again the question of correct allowance for batter comes in. The dredgemaster should work out the angle in the same way as does the surveyor and add to the visible length that length which when multiplied by the depth and width gives the same volume that the surveyor has added.

Condition III.—This is the case of a dredge working in a solid piece of ground with tailings hard on the left (Fig. 6). Tailings do not lie cemented and consequently a greater falling-in occurs, both while actually dredging and after the dredge has gone forward. As indicated in the figure, if, after the dredge has gone forward the tailings drop in, then the surveyor's mark for the visible finish of the face will not coincide with the post the dredgemaster had in while on that particular

piece of ground. As is shown in the figure, the tailings will actually overlap a piece of the bottom that has already been cleaned up and they will have taken up a different angle. The best that can be done is to work from the amount of fall-in seen while actually dredging and the nominal slope of 45° . The return will be low over the month, but that is better than being high.

DEPTH.—When a depth indicator on a dredge has been properly set and allowance made for the slack of the buckets there should be no error from the actual recorded depths. From that, it would appear that all that can be said has already been said, but there are three things worthy of mention. Firstly, if a dredge is tight behind and is being thrust ahead, it is an impossibility to clean bottom—one cut overlapping as it should. Fig. 7 shows the shape of the bottom when a dredge is being shoved ahead. The buckets hit bottom, but at such distance as 12 and 18 ft. in full ahead there is a very considerable portion of the bottom left behind. If this is true the average depth as shown on the chart will be very far out. However, things should not reach this stage, for, if a dredge is corrected in her width the bottom will look after itself. Then sometimes there is a considerable height of bank above water level. In this case the mean height should be worked out and added to the average depth. Also—thirdly, when working in a deep hole, the height of water above the gravel should be deducted from the average depth.

THE STEAM-SHOVEL IN NIGERIA

At the meeting of the Institution held in May, the application of the mechanical shovel to the working of the Nigerian tin-deposits was described by W. E. Sinclair. The author said that the history of alluvial tin mining in Nigeria does not offer any conspicuous examples of big-scale mining aided by plant or machinery, and, with few exceptions, the introduction of plant and machinery of any sort has not been successful, and, since the advent of steam shovels and draglines to this field, a certain number of mining engineers have supported popular opinion as to the failure of this class of plant, even under normal conditions. A few far-seeing engineers decided, however, that one of the problems to be tackled was the breaking of ground rapidly and cheaply, and to this end decided on the use of excavating machinery, with the result that draglines and shovels are now being used to a small extent.

A general review of all excavating machinery which has been and is being employed on these fields, does not show that any direct fault can be found in the machines themselves or in the work they are doing. In general they are doing work which otherwise would call for enormous reserves of labour or large resources of water, in neither of which commodities is Nigeria plentifully endowed.

The apparent outstanding difficulties experienced in shovel-mining in Nigeria would seem to fall under the following headings:—

(1) Where all ground broken by shovels or draglines is being sluiced:—

(a) Blockage of sluices.

(b) Shortage of water.

(c) Low capacity or efficiency of machine due to (a) and/or (b), or other plant working in conjunction with the excavator.

2. Where all ground broken by shovels is dumped back (stripping overburden).

(a) Cramped position owing to dumped overburden coming back on the machine and consequent necessity for the double handling of a proportion of the dump.

(b) Bad travelling conditions causing loss of time in moving machine up to the face.

(c) Dumps sliding back on to the machine or on to the wash exposed.

(d) Falls of ground.

(e) Low capacity or low efficiency due to other plant working in conjunction with the stripping shovel.

(f) Low capacity due to time lost in coaling, oiling, or taking water.

GENERAL.—A résumé of the difficulties experienced in stripping overburden by means of large revolving shovels resolves itself chiefly into a question of suitable conditions, that is, shovels competent to tackle the ground and ground suitable for shovels, allowing for such important factors as drainage, length of deposit, depth of ground, and value of ground, and finally the methods of handling the wash exposed and the auxiliary plant used in connexion therewith. All of which means, first, the careful study of every detail before the plant is installed, and, secondly, a practical and exact lay-out planned in advance, both on paper, by means of accurate plans and sections of the deposit, and on the area itself. Large mechanical plants of any description should not be placed on a deposit of alluvial tin without careful consideration, and this point is even more important in the case of steam shovels.

The question of lubrication in a machine of the shovel is important, and a short stop at

intervals for the purpose of examining and oiling moving parts is recommended. At the same time there is always room for improvement in lubricating arrangements, especially after a machine has been running for any length of time. Most of the revolving shovels are now fitted with an arrangement whereby water can be taken into the tank while the machine is running.

Value of Ground.—One of the considerations mentioned above is what must be the value of the ground in order that a deposit can be profitably mined by means of shovels? There is no known formula and few examples locally from which a solution can be arrived at, so that the point remains a problem. It is suggested, however, that a method might be employed where a fairly accurate idea as to what constitutes a payable deposit may be arrived at. First, it must be assumed that, if a shovel is to be employed to strip the overburden, the whole of the value is contained in the wash. Secondly, it is assumed that the mean stripping cost per yard on the shovel to be employed is known, and also its rate per hour. Finally, it must be assumed that the cost of breaking, handling, and dressing a cubic yard of wash under varying circumstances is a known factor, since this operation is much the same under varying conditions, no matter what means are employed to expose the wash. Then, given the depth of ground, width and value of the wash, the next logical step is to calculate a ratio of cubic yards of overburden to a cubic yard of wash, in order to determine the amount of overburden to be removed to expose one cubic yard of wash. Incidentally, this ratio will give the required rate of working, and is a foundation for the determination of the auxiliary plant necessary to keep pace with the stripping shovel. To illustrate the ratio factor of overburden to wash, the cases of two deposits having the same wash value, but of different depths, are quoted. The costs on stripping and handling of wash are assumed to be the same in each example, viz. :—

Cost of stripping by shovel . 9d. per cub. yd.
 Cost of breaking, handling,
 and dressing wash 2s. per cub. yd.

EXAMPLE 1.

Average depth of deposit . 24 ft.
 Ratio of overburden to wash 7 : 1
 Overall value of ground . 3 lb. per cub. yd.
 Value of wash 24 lb. per cub. yd.

TOTAL COST OF HANDLING.

Stripping, 7 cub. yd. at 9d. . 5s. 3d.
 Wash, 1 cub. yd., at 2s. . 2s.
 Therefore, total cost for recovery of 24 lb. Sn. concentrates is 7s. 3d.

EXAMPLE 2.

Average depth of deposit . 54 ft.
 Ratio of overburden to wash 17 : 1
 Overall value of ground . 1.33 lb. per cub. yd.
 Value of wash 24 lb. per cub. yd.

TOTAL COST OF HANDLING.

Stripping, 17 cub. yd. at 9d. . 12s. 9d.
 Wash, 1 cub. yd. at 2s. . 2s.
 Therefore, total cost for recovery of 24 lb. Sn. concentrates is 14s. 9d.

This solution is therefore dependent on the method and cost of handling the wash and on the current price of the metal, the cost per yard of stripping being a constant.

Actually the cost of breaking ground by means of shovels varies considerably according to capacity

and conditions, but, generally speaking, over any period a fair average is realized.

Variations in running costs on machines of this type are due chiefly to one or more of the following causes: (1) Mechanical breakdowns; (2) the human factor; (3) unforeseen delays.

The expense for repairs of shovels or draglines, if called upon to work continuously under severe conditions, must become a large item, especially if the machine in question has passed through some years of service. The maintenance and repair cost on any particular shovel will, therefore, vary in direct ratio to the age of the machine, and vary considerably in machines of different sizes and capacities.

Mechanical breakdowns can be allowed for as a certain percentage (say, 7%) of lost time in total running time, so long as these accidents are not directly due to bad operating or carelessness on the part of the driver.

The human factor.—A large factor of safety is put into the structure and mechanical construction of a shovel, to allow for the abnormal stresses and strains to which such a machine is subjected, and for the human element. The life of the machine and its efficiency are, therefore, more or less in the hands of the operator, although this can to a large extent be controlled by efficient supervision. One of the common failings of even a careful and speedy operator, which seriously affects yardage and therefore costs per yard, is the inability to fill the bucket to overflowing in each cut; this is generally due either to swinging clear before making the full cut from bottom to top of face, and so failing to bring the bucket and arms up to a horizontal position, or to insufficient 'crowding motion' during the cut, due to bad judgment or over-cautiousness.

Time is invariably lost at change of shifts owing to unnecessary talk between the relieving operator and the one being relieved. All matters concerning the previous shift should be entered in a log-book on the machine, which would give all the information to the operator taking over and so make long discussions unnecessary. This log also constitutes a record for the Manager and gives details and figures for statistics and reports.

Supervision.—The importance of efficient supervision on a shovel proposition cannot be over-emphasized, for, to a great extent, the efficiency of the work, the yardage handled, and the cost depend on the manager, who should be qualified to handle men and to have sufficient mechanical knowledge to understand every detail of the machines under his charge, otherwise there may be a tendency for operators to take advantage of the manager's lack of knowledge by slacking or bluffing. In order to avoid this state of affairs, the management is often tempted to resort to a bonus system. Under these circumstances this step would appear to be a sign of weakness. On the other hand, in certain circumstances where operators and crew have undoubtedly difficult working conditions, or are expected to work long hours, it is reasonable to give a bonus for the yardage moved. In this connexion, a bonus system which works satisfactorily and does not increase costs is one based on an overtime basis, i.e. cubic yards broken per hour in time worked over the normal eight-hour shift, and on the yardage handled over and above the average or tested capacity of the machine, in conjunction with a sliding scale based on the coal

consumption, i.e. cubic yards of ground handled per ton of coal consumed.

Most charges against the shovel continue whether the machine is digging or at rest, therefore it is imperative that stoppage time be reduced to a minimum; continuous running is better than a single day-shift or a double eight-hour shift. It is generally admitted that efficiency is not maintained on night work, but on a shovel with good operators there is little difference between day and night conditions, so long as good flood lamps are employed besides those usually fitted on the machine. A cramped machine cannot be expected to break ground at a low cost. Feed-water arrangements are important, so that no loss of time is incurred in getting feed-water to the tank and boiler.

Unforeseen delays will occur, but these can generally be minimized by careful foresight on the part of the management in the general layout, which should be mapped out in detail a few months ahead of the current work. Large stripping shovels have proved extremely useful for raising or lowering plant out of or into the cut. Work of this nature should be correctly allocated, otherwise the cost of stripping will suffer. The running time and digging efficiency of a large revolving shovel is indicated in the following record, which covers a long period under fairly difficult conditions:—

Total running time	100.0	
Digging	61.5	
Coaling and oiling	14.4	Difficulty in getting coal to the machine and small bunker capacity.
Travelling	12.3	Bad conditions.
Mechanical and maintenance	8.3	
Other delays	3.5	Lowering and lifting plant and passing plant in cut.

Digging efficiency must vary considerably according to local conditions, nature of ground, and capacity of the shovel, and cost of stripping will vary in direct ratio, so that it would cause confusion to quote various examples in Nigeria. It suffices to say that shovels have broken ground, and dumped it under conditions and at a price that could not have been achieved by the local labourer, or any other competitive plant that could be employed under such conditions. On the other hand, mechanical excavators of the wrong type under unsuitable conditions and inefficient management will prove an unprofitable undertaking, which, of course, will apply to most other plants.

DRAGLINES.—Draglines have not yet been employed to strip the overburden off the wash on deep deposits in Nigeria, as is being done by the large revolving shovels, but thought has been given to this question, and there is no doubt that a time will come when draglines will be tried out on this method of working, especially on the deeper ground which is of an unsuitable nature for shovels. The only obvious difference in the method of attack is that the dragline works from the top of the bank, that is, it travels along the surface on ground level, and in this way presents the following advantages over the shovel working down in the bottom of the cut: (1) The dragline has much easier travelling conditions; (2) less chance of being cramped; (3) no danger from falls of dump or bank; and (4) allows more room in the bottom of the cut for wash operations.

These factors are a decided consideration when certain conditions are studied. If, for instance, a deposit is suitable in every way for stripping by shovels, but the overburden is of a moist clayey nature, and is not likely to stand when opened up, and for the same reason dumps are liable to slide, then a drag working from the bank would be free of any of the difficulties mentioned, and would be in a position, by reason of its superior dumping radius, to deal successfully with such conditions. In spite of these advantages, however, the suitability of a dragline under certain conditions is dependent on factors as in the case of a steam shovel. There is naturally a limit to the depth of ground which can be successfully handled. Given the correct machine for a given depth of ground, a certain width of face must be maintained in order to obtain a bulk of broken ground which can be dumped clear of the exposed wash.

It will be realized that when a dragline is first established on a deposit, a pilot cut, as in the case of working by means of shovels, is the primary layout. This pilot or box cut is not a straight-forward procedure in the case of a dragline opening up a deposit with no open or free side. The dumping height of a dragline, when dumping ground on its own level (that is, on top of the bank), is considerably reduced, so that the amount it is able to stack is less than one-third of what it is able to dump when throwing back into an open cut below its own level; consequently some scheme must be employed to overcome this handicap in the initial cut. After the pilot cut has been excavated, a dragline travels along the edge of the open cut on the strip of ground which it is in the process of stripping. This procedure is not possible when opening up the pilot cut, for the reason that, in order to excavate a cut wide enough, there would be more broken ground than could be comfortably dumped, or the pilot cut would have to be made too narrow to be of any use.

The advantages gained by stripping deep ground by means of draglines, as compared with shovel operations, have already been mentioned. Besides these considerations other minor advantages are gained, such as easy accessibility in case of repairs, better conditions for operators, more satisfactory lighting for night work, no loss of time in passing other plant in the cut, no need for bench of wash to be left on each cut, and fewer abnormal breakdowns and mishaps to the machine. Also when the deposit is worked out, it is advantageous to have the dragline on the surface, and so ready to move off to a new site. Where the wash has previously been partly worked by tributaries or by underground methods, the trouble now experienced in travelling large shovels over such broken ground would be entirely eliminated. Draglines can, therefore be used to advantage in stripping partly-worked ground, for such a machine has an added advantage in being able to level up its own road when travelling over rough or broken ground.

To offset these advantages, however, mention must be made of certain disadvantages that will be apparent in this method of working:

1. If ground should be tough or hard, there is a possibility that difficulty will be found in getting down to the bottom stripping level. Where the action of cutting down is more or less dependent on the weight of the bucket, the bucket can be weighted in order to overcome the difficulty.
2. The skill of the operator is more important

in dragline than in shovel work. The throw of the bucket in order to grade the bottom, the side-cutting to obtain a batter on the bank, call for an experienced operator.

3. Breaking ground is usually a slower procedure with a dragline than with a shovel of the same capacity, due principally to the fact that the actions are not so positive, and speed of digging is, therefore, entirely dependent on the skill of the operator.

4. Where ground is soft and liable to break away, there is always the danger of the bank giving and the machine sliding down into the cut. The nature of the ground will show what angle of batter it will be necessary to maintain in order to guard against this danger.

5. The supply of feed-water to a steam dragline will not be as simple as it usually is in the case of shovels, where advantage can be taken of gravity to feed water to the tanks and the boiler.

Manganese in the United States during 1929.—

The Bureau of Mines, Department of Commerce, Washington states that there was an increase of about 30% in shipments of manganese ore containing 35% or more of metallic manganese from mines in the United States in 1929. Shipments totalled approximately 61,000 tons, valued at \$1,926,000, as compared with 46,860 tons, valued at \$1,214,853 in 1928. The shipments of metallurgical ore during the year amounted to about 48,000 tons, valued at \$1,380,000, as compared with 31,430 tons, valued at \$593,561 in 1928, while chemical ore shipments decreased from 15,430 tons, valued at \$621,292 in 1928, to about 13,000 tons, valued at \$546,000 in 1929. The relatively large increase in 1929 was mainly due to the increased output from the plant of the Domestic Manganese and Development Co., at Butte, Montana. This company treated in its mill about 50,000 tons of rhodochrosite averaging 37.6% manganese from which was produced about 30,000 tons of sinter averaging 57.7% manganese. During 1928 this company treated about 18,600 tons of crude ore containing 37% manganese, and obtained 11,118 tons of nodular product averaging 57% manganese. Chemical ore shipments from Phillipsburg amounted to 12,800 tons in 1929, as compared with 14,689 tons in 1928. Shipments of high-grade ore from Arkansas were about 3,600 tons, as in 1928; Arizona shipments decreased from 3,507 tons in 1928 to about 2,600 tons in 1929; Georgia shipments likewise decreased from 4,727 tons in 1928 to 2,500 tons in 1929; Idaho showed little change; New Mexico shipments increased from 2,627 tons in 1928 to about 2,900 tons in 1929; Tennessee shipments showed a marked increase from 55 tons in 1928 to over 500 tons in 1929, while Virginia's decreased slightly.

Figures furnished by the Bureau of Foreign and Domestic Commerce show that during the first eleven months of 1929 the United States imported 630,083 tons of ore containing 308,113 tons of manganese. Assuming that the imports for December last were at the same rate as in November, the total tonnage imported would be approximately 680,000 tons containing 332,000 tons of manganese, as compared with 427,708 tons of ore containing 207,808 tons of manganese during 1928. The imports from Soviet Russia for the first eleven months amounted to 328,861 tons of ore containing 168,874 tons of manganese, compared with 159,842 tons containing 79,529 tons of the

metal in the entire year of 1928; Brazil furnished 194,335 tons containing 84,569 tons of manganese during the first eleven months of 1929 as compared with 142,300 tons containing 64,290 tons of manganese during all of 1928; imports received from India amounted to 67,440 tons containing about 34,619 tons of manganese during the first eleven months of 1929, as compared with 83,600 tons containing 43,072 tons of manganese in 1928; while British West Africa (Gold Coast) furnished 27,587 tons of ore containing 13,258 tons of manganese for the first eleven months of 1929, as compared with 24,186 tons containing 11,712 tons of manganese for the entire year of 1928. The increased (over double) imports from Soviet Russia is worthy of note. For the first eleven months of 1929 the manganese content of ferro-manganese imported was 58,956 tons as compared with 48,844 tons for the entire year 1928. The imports for the entire year 1929 are estimated at 63,600 tons of manganese content, equivalent to 79,500 tons of ferro-manganese, or 150,000 tons of ore.

There was a record production of steel in 1929, estimated at 56,100,000 tons of ingots and castings, compared with 51,544,180 tons in 1928, and a consequent demand for ferro-manganese and in turn for manganese ore. The estimated production of ferro-manganese in 1929 is given in the *Iron Trade Review* of January 2, 1930, as 333,800 tons, the largest output on record, compared with 319,770 tons in 1928. The rate of consumption of manganese ore in the manufacture of ferro-manganese, as reported for 1928 by ferro-manganese producers was 1.891 tons of ore per ton of product. At this rate the production of ferro-manganese in 1929 would have required about 631,000 tons of ore. For this purpose the supply was ample: that is, 60,000 tons of domestic high-grade ore plus 680,000 tons of imported ore minus about 45,000 to 50,000 tons diverted for "chemical" uses, a balance of 690,000 to 695,000 tons. About 63,600 tons of ferro-manganese, equivalent to 150,000 tons of ore (figured on the same percentage of recovery as in domestic manufacture) was imported for consumption in 1929. This figure added to the requirements of domestic ferro-manganese producers (631,000 tons) would indicate that the total metallurgical requirement in the United States in 1929 was probably in the neighborhood of 781,000 tons.

The shipments of domestic ore containing from 10 to 35% of manganese (ferruginous manganese ore) in 1929 were 77,000 tons, valued at approximately \$419,000, as compared with 90,581 tons, valued at \$407,289 in 1928. The domestic shipments of ore containing from 5 to 10% of manganese (manganiferous iron ore) in 1929 were 1,100,000 tons, valued at \$2,772,000 as compared with 1,085,401 tons, valued at \$2,645,145 in 1928.

Copper in Converter Slag.—Recent changes in metallurgical practices, particularly those in flotation, have altered greatly the functions of the different units of a copper smelter. Gangue minerals are removed from the feed so much more thoroughly that the reverberatory furnace, once virtually a concentrator in which a low grade ore was concentrated into a rich matte by virtue of the removal of gangue elements as slag, has become very largely a melting furnace in which the rich flotation concentrates are rendered molten so that

they may be converted. Moreover, since the proportion of matte to slag in the reverberatory furnace output is greater than it was formerly, the amount of converter slag returned to the reverberatory for cleaning is, in comparison to the amount of slag actually formed in that furnace, also much larger. In some cases, approximately half of the reverberatory dump slag may have originated in the converter. The increase in the proportion of converter slag to total slag produced has brought about certain consequences not entirely desirable. Converter slags contain a high percentage of iron and therefore are high in specific gravity and are very basic. A considerable quantity of magnetite, both dissolved and suspended as solid crystals, is always a component. The basic nature of the ordinary converter slag and the presence of the suspended magnetite crystals make impossible the reduction of the copper content of the slag below approximately 1% by even the most prolonged settling, and a re-treating process is necessary. At present, general practice in western copper smelters is to return the converter slag molten to the reverberatory furnace. Here dilution by mixing with slag formed in the reverberatory furnace and reaction with raw sulphides and siliceous materials in the reverberatory feed reduce the magnetite and increase the silicates to the point necessary for a satisfactory dump slag.

This method of re-treating converter slag, although very simple, does not always go so smoothly as this brief description would indicate. After entering the reverberatory bath, converter slag, because of its greater density, often shows a tendency to form a more or less distinct layer immediately above the matte. Such a layer, mushy in consistency because of suspended magnetite crystals, interferes with proper furnace operation. It hinders the matte newly formed in the smelting zone from settling out of the slag; the extremely basic character of the layer makes for greater corrosion of the side walls of the furnace at the point where matte and slag meet, and the suspended magnetite, in the case of furnaces producing a low-grade matte, may sink through the matte and gradually deposit a layer of crystalline magnetite on the bottom of the furnace. The growth of such a layer tends to become more and more rapid, since as it thickens, the depth of matte through which the magnetite crystals must sink is lessened. An economically and technically feasible mechanical method of re-treating converter slag would, by avoiding these difficulties, make possible greater furnace capacity, a more siliceous and cleaner slag, and less corrosion of the furnace sidewalls. However, in order to judge correctly as to the feasibility of various possible methods of cleaning converter slag, one must first know the chemical and physical state of the copper content of the slag. The results of an investigation carried out in Arizona by the United States Bureau of Mines are summarized as follows by F. S. Wartman and W. T. Boyer in Report of Investigations 2985, recently published.

Chilled or quickly-cooled converter slag is difficult to grind and the copper-bearing compounds are so finely disseminated that they are not freed by grinding through 200 mesh. Slowly-cooled or crystallized converter slag is much easier to grind than chilled slag and the copper-bearing compounds are segregated in granules of such size that they are largely freed from the slag by grinding them through 150 mesh. Neither silver nitrate, sulphurous acid, nor a mixture of sulphurous, hydrofluoric, and

pyrogallol acids will distinguish between prill and dissolved copper, or between sulphide and oxide copper in the slag with an accuracy greater than 10% of the total copper content of the slag. The copper content of the first slag skimmings from the converting of low- or medium-grade matte is in the form of sulphide or metallic copper. Slags skimmed near the white metal stage may contain an appreciable proportion of the copper content in the oxidized form. The whole body of the slag produced in converting a matte containing 30% copper will have about 90% of the copper content in the metallic or sulphide form.

As slowly-cooled converter slag produced from the converting of low or medium grade mattes is easily ground, and the copper-bearing compounds are largely freed by grinding through 150 mesh, and since the copper content is approximately 90% in the sulphide or metallic form, it is believed that the cleaning of this type of slag by the flotation process is possible.

Determination of Cadmium.—The use of the metal, cadmium, has increased greatly in the past few years, due to its application in steel plating. The metal is obtained as a by-product in the metallurgy of zinc. The minerals of cadmium almost invariably occur in very minute quantities in zinc ores. The relative amounts of cadmium in the complex lead and zinc ores of the Salt Lake District in Utah range from negligible quantities to one part of cadmium to 200 parts of zinc.

Because of the increasing importance of cadmium, research on the recovery of cadmium from zinc mineral concentrates is being conducted at the Intermountain Experiment Station of the United States Bureau of Mines, Department of Commerce, in co-operation with the University of Utah. In making this research, considerable trouble was encountered in determining the cadmium content of the various zinc concentrates and the products obtained in connexion with the work, because of the chemical similarity of the elements, and because of small amounts of cadmium which were present as compared to the large quantities of zinc. An average zinc concentrate of this district contains 0.2% cadmium and 55 to 60% zinc. Ordinary routine analyses for substances which are relatively simple when compared to the determination of cadmium, are accurate when they differ by 0.1 or 0.2%. Considering the content of cadmium to be dealt with, such accuracy is entirely inadequate. Several methods for determining cadmium, obtained from various sources, were more accurate than the percentage given above, but were long and complicated and caused a great deal of delay in the conduct of the work. Accordingly, the literature was searched for methods, or parts of methods, that would be suitable for the purpose. As a result, a method was developed which was partly original and partly taken from the literature, which is of a degree of accuracy that is satisfactory and is also short and simple.

The essential steps in the determination are solution in the usual way; precipitation of copper, bismuth, arsenic, and antimony with iron; removal of lead as the sulphate; separation of cadmium from manganese, zinc and iron by precipitation of the cadmium, with ammonium sulphide, as cadmium sulphide, in a solution of carefully controlled acidity; conversion of the separated cadmium to cadmium ammonium phosphate; ignition of the latter; and weighing as cadmium pyrophosphate.

The above determination is accurate to 0.01 to 0.02% and can be completed in 24 hours, which time includes the overnight precipitation of cadmium ammonium phosphate. The method has been entirely satisfactory when applied to zinc concentrates and the various products obtained in connexion with the experimental and research work that is being conducted on the recovery of cadmium from zinc concentrates.

Gold Values in Copper Ores.—In the large scale flotation plants for the concentration of copper minerals, the precious metal value is usually so low that its recovery is given little consideration. The Rare and Precious Metals Experiment Station of the United States Bureau of Mines, in co-operation with the University of Nevada, Reno, Nevada, has made a study of gold and silver occurrence in a particular ore where the copper is present largely as chalcopyrite associated with pyrite, pyrrhotite, magnetite and the usual gangue. The gold content, about 90 cents per ton, appears to be free except that it may be partially coated with carbon.

In plant practice an average of only 50% of the gold goes with the concentrate. The experiments show that the low recovery of gold is due to the solution circuit carrying lime to almost the point of saturation. A series of laboratory flotation tests on the original ore following plant practice in which the nearly saturated lime solution was decreased in steps to nearly neutral solution, other reagents remaining the same, gave correspondingly increased gold recovery from 50% up to 85% with practically the same copper concentration. Finer crushing further increased the recovery. In this particular plant a lime scale high in gold value collects on parts of the flotation apparatus. A quantity of this scale was collected. The contained lime was carefully removed by weak acid. The remaining gold residue was mixed with fine clean sand. Equal portions of this mixture were used in similar flotation tests where the only variable was 1, 2, 3, 5, and 10 lb. of lime per ton of ore. The results show a concentration of the gold decreasing with the increased alkalinity as follows: 95% with pH 7.7; 93% with pH 9; 92% with pH 9.8; 86% with pH 10.2; 78% with pH 11.4; 51% with pH 12.4. The concentration of the silver minerals is approximately the same percentage as that of the copper minerals.

Microscopic Work on Sulphide and Oxide Ores.—The principal function of the microscopic laboratory at the Inter-mountain Experiment Station of the United States Bureau of Mines, Salt Lake City, Utah, has been to study and determine the physical characteristics of the low-grade and complex sulphide and oxide ores and their concentration products with a view to determining or improving ore treatment methods.

The procedure involves the study of highly polished specimens, of approximately 1 in. diameter, by reflected light at magnifications of from 100 to 1,000 diameters. The purpose of these studies is as follows: (a) To identify the sulphide minerals; (b) to establish the approximate grain size of the several constituents to serve as a guide for crushing required to secure liberation; (c) to study thin sections to ascertain relation of sulphide particles to gangue and products of rock decomposition, and (d) to establish by a statistical counting method the relative abundance of the various minerals in an ore, when three or more minerals are present.

The procedure also includes the study of crushed

minerals such as concentrates, middling products, or tailings, to ascertain the following: (a) The percentage of total metal content represented by each mineral constituent; (b) whether tailing losses are due to failure to recover any one particular mineral or to some physical characteristic such as surface oxidation, contamination with clay, graphitic matter, etc., and (c) the extent to which unliberated or middling grains occur and the percentage of total metal thus represented.

The study of crushed material, concentrates, tailings, etc., is done at magnifications of from 100 to 1,000 diameters, but the mineral particles are first incorporated into briquets, using sealing wax, bakelite resin, or similar substances as a binder. Such briquets are highly polished for study in the same manner as the uncrushed mineral specimens.

SHORT NOTICES

Open-cast Mining.—Earl E. Hunner describes some recent developments in open-pit mining on the Mesabi Range in Technical Publication No. 333 of the American Institute of Mining and Metallurgical Engineers.

Misfires in Blasting.—Technical Paper 471 of the Bureau of Mines, Washington, by L. C. Isley, A. B. Hooker, and D. H. Zellers, shows how leakage of current from an electric shot-firing circuit causes misfires.

Gravity Concentration.—The *Journal of the Chemical, Metallurgical and Mining Society of South Africa* for February contains an article by Prof. F. J. Tromp and Mr. E. Beyers on the effect of dissolved substances on gravity concentration.

Ore Dressing.—G. B. O'Malley commences a discussion of the trend of ore dressing in U.S.A. and Canada in the *Chemical Engineering and Mining Review of Melbourne* for April.

Antimony.—The development of the metallurgy of antimony during recent years was discussed by C. Y. Wang in a paper read before the World Engineering Congress at Tokyo.

Blast-furnace Operation.—The effect of sized ore on blast-furnace operation is discussed by S. P. Kinney in Technical Paper 459 of the Bureau of Mines, Washington.

Central African Metallurgy.—Part IV of a series of articles by Prof. P. Kovaloff on the copper deposits of Northern Rhodesia and the Belgian Congo, appearing in the *Mining and Industrial Magazine of Southern Africa* for April 30, gives some notes on the mining and on the development of the metallurgical treatment of the ores of the Congo-Zambesi watershed.

Separation of Nickel and Cobalt.—The separation of nickel and cobalt by means of hypochlorite is described by F. H. Rhodes and H. J. Hosking in *Industrial and Engineering Chemistry* for April 15.

Compressed Air.—A system of reducing wastage in the use of compressed air underground is described by C. E. Donne in the *Journal of the Underground Officials' Association of South Africa* for March 10.

Gold-bearing Quartz in Canada.—The structure of gold-bearing quartz in Northern Ontario and Quebec is discussed by G. W. Bain in Technical Publication No. 327 of the American Institute of Mining and Metallurgical Engineers.

Radium in Ontario.—H. S. Spence and R. K. Carnochan give a description of the occurrence of radium ore near Wilberforce, Haliburton County,

in the *Bulletin* of the Canadian Institute of Mining and Metallurgy for May.

Beardmore-Nezah Gold Area, Ontario.—The geology of the Beardmore-Nezah Gold area, Ontario, is described by G. B. Langford in *Economic Geology* for May.

Gold in South Africa.—An article on the gold deposits of the Union of South Africa by Dr. P. Kukuk appears in *Gluckauf* for May 10.

Origin of Gold in Rand Banket.—A supplement to *Economic Geology* for May contains the first part, entitled the "Testimony of the Conglomerates", of a thesis by Dr. L. C. Graton on the hydrothermal origin of the Rand gold deposits.

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.

36,983 of 1928 (327,956). I. G. FARBENINDUSTRIE A.-G., Frankfort-on-Main, Germany. Reducible metallic compounds are converted into carbonyls without special previous reduction by treatment with carbon monoxide at elevated uniform temperatures under pressure.

116 of 1929 (303,513). FRIED. KRUPP GRUSONWERK A.-G., Magdeburg-Buckau, Germany. Magnetic fields existing between drum-armature and magnetic poles are utilized in series for a double separating operation of magnetic materials.

337 of 1929 (327,687). J. HERRMANN and B. G. FRANZEN, Germany, and L. MACB. HUBBARD and E. R. ZACHARIAS, New York. Molten ore is circulated about a magnetic axis in a chamber wherein it is simultaneously subjected to hot gases and to magnetic influence, whereby the gases react with the ore and a certain magnetic separation takes place.

606 of 1929 (303,755). A. PACZ, Cleveland, Ohio. Alumina prepared from the usual ores by the action of salts of at least two alkali metals as solvents is found suitable for the preparation of aluminium, and the metal prepared has improved properties.

2,350 of 1929 (327,778). K. BAUMGARTNER and F. SCHMIED, Czecho-Slovakia. Apparatus for filling in disused mine workings.

5,065 of 1929 (306,048). V. VOLPATO, Milan. Iron and steel scrap are subjected to magnetic forces for a prolonged period and then subjected to acid treatment for the preparation of gold and silver.

10,306 of 1929 (309,038). I. G. FARBENINDUSTRIE A.-G., Frankfort-on-Main, Germany. Apparatus for performing electrometric volumetric analysis.

12,416 of 1929 (316,542). SACHTLEBEN A.-G. FÜR BERGBAU UND CHEMISCHE INDUSTRIE, Germany. Impure barytes in lump form is treated at a temperature of 1300–1350° C. and quenched, whereby the impurities are rendered into such a state that subsequent acid treatment is greatly simplified.

16,691 of 1929 (313,166). L. V. CORSA, Turin. A new electrolyser for the separation of tin from tin solutions.

19,837 of 1929 (328,162). SOC. ANON. LA NOUVELLE MONTAGNE, Engis, Belgium. A pulverulent mixture of raw blende and pre-roasted blende is sprayed with water, a solution of zinc sulphate, or dilute sulphuric acid, in such a manner that separate granules are produced which harden owing to the formation of oxy-sulphate of zinc.

20,484 of 1929 (317,001). METALLGESELLSCHAFT A.-G., Frankfort-on-Main, Germany. Metallic ores containing fuel constituents such as sulphur, arsenic or antimony are heated in three successive stages whereby slagging, which might interfere with desulphurization, is prevented.

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.

Aluminium and its Production. By T. D. EDWARDS, F. C. FRARY, and Z. JEFFRIES. Cloth, octavo, 2 vols, 358 + 870 pp., illustrated. Price 60s. New York and London: McGraw-Hill.

Metalliferous Mine Surveying. By T. G. HANTON. Cloth, octavo, 224 pages, illustrated. Price 15s. London: Crosby Lockwood and Son.

Structure of Typical American Oilfields. A symposium. Vol. II. Cloth, octavo, 780 pages, illustrated. Price 27s. American Association of Petroleum Geologists. London: Thomas Murby and Co.

Oil Fields in the United States. By Dr. W. A. Ver Wiebe. Cloth, octavo, 629 pages, illustrated. Price 30s. New York and London: McGraw-Hill.

Bergbaumechanik. Textbook for mining institutions and handbook for practical mining. By Dipl.-Ing. J. MAERKS. Paper boards, 451 pages, illustrated. Price 19.50 marks. Berlin: Julius Springer.

The Scientific Fundamentals of Gravity Concentration. By JOSEF FINKEY. Translated by C. O. ANDERSON and M. H. GRIFFITHS. Paper covers, 295 pages, illustrated. Price \$1. Bulletin No. 1, Vol. II, School of Mines and Metallurgy, Rolla, Missouri.

The Mines of Mendip. By J. W. GOUGH. Cloth, octavo, 269 pages, illustrated. Price 15s. Oxford: Clarendon Press.

Mining Laws of the British Empire and Foreign Countries. Vol. XII. Northern Rhodesia. Paper boards, 145 pages. Price 10s. 6d. London: H.M. Stationery Office.

Forest Products Research. Project I: Progress Report 2. Tests of some home-grown timbers in their green and seasoned conditions. Paper covers, pp. iv + 10, illustrated. Price 1s. London: H.M. Stationery Office.

Nova Scotia. Annual Report on the Mines, 1929. Part I. Paper covers, 273 pages, illustrated. Halifax: Department of Public Works and Mines.

Canada. Report of the Department of Mines for the fiscal year ending March 31, 1929. Paper covers, 58 pages. Price 25 cents. Ottawa.

Artificial Abrasives and Manufactured Abrasive Products and their Uses. By V. L. EARDLEY-WILMOT. Paper covers, 144 pages, illustrated. Price 20 cents. Ottawa: Department of Mines.

Aerial Exploration. Preliminary Report on the Aerial Mineral Exploration of Northern Canada. By G. H. BLANCHET. Paper covers, 32 pages, illustrated. Ottawa: Department of the Interior.

Western Australia. School of Mines of Western Australia. Bulletin 5. Reports on investigations conducted in the metallurgical laboratory. By W. G. CLARKE and B. H. MOORE. Paper folio, 42 pages. Perth: Mines Department.

Commercial Possibilities of the Texas—New Mexico Potash Deposits. By J. S. WROTH.

Paper covers, 144 pages, illustrated. Price 25 cents. Bulletin 316, Washington: Bureau of Mines.

International Trade in Mica. By J. ULMER. Paper covers, 70 pages. Price 15 cents. Trade Promotion Series—No. 95, Washington: Department of Commerce.

The Rawlins, Shirley and Seminoe Iron ore Deposits, Carbon County, Wyoming. By T. S. LOVERING. U.S. Geological Survey; Contributions to economic geology, 1929, Part I, pp. 203-235. Price 10 cents.

The Granby Anticline, Grand County, Colorado. By T. S. LOVERING. U.S. Geological Survey; Contributions to economic geology, 1930, Part II, pp. 71-76. Price 5 cents.

Titanotheres of Ancient Wyoming, Dakota and Nebraska. By H. F. OSBORN. Two vols., cloth, quarto, 953 pages, illustrated. Monograph 55, U.S. Geological Survey, Washington.

Mineral Resources of the United States, 1928. Part I, pp. 105-143, Rare Metals, by F. L. HESS; pp. 321-346, Tin, by C. W. MERRILL; pp. 347-362, Lead and Zinc Pigments and Salts, by E. W. PEHRSON; pp. 363-421, Zinc, by E. W. PEHRSON. Part II, pp. 175-186, Lime, by A. T. COONS; pp. 221-225, Silica; pp. 227-235, Barytes and Barium Products, by R. M. SANTMYERS and B. H. STODDARD; pp. 237-252, Abrasive Materials, by O. BOWLES; pp. 253-275, Phosphate Rock, by B. L. JOHNSON; pp. 277-292, Sand and Gravel, by E. R. PHILLIPS; pp. 293-335, Stone, by A. T. COONS. Each part in paper backs, price 5 or 10 cents. Washington: Bureau of Mines.

Lake Superior Mining Institute. Proceedings of the Houghton, Michigan, meeting, Sept. 1929. Vol. XXVII. Paper covers, 357 pages, illustrated. Lake Superior Mining Institute: Ishpening, Michigan.

La Zona Antracifera de Huayday. By T. BALTA. Paper covers, 90 pages, illustrated, with maps. Bulletin No. 6, National Coal and Iron Commission: Lima, Peru.

German-English Dictionary, of Technical, Scientific and General Terms. By A. WEBER. Cloth, octavo, 887 pages. Price 36s. London: George Routledge and Sons.

African Manual. Mining, Industry and Agriculture, 1929-30. Edited by C. CARLYLE-GALL. Cloth, octavo, 1,110 pages, illustrated. Price 21s. London: Mining and Industrial Publications of Africa.

South African Mining and Engineering Year Book, 1930. Edited by S. R. POTTER and J. B. BULLOCK. Paper boards, quarto, 612 pages, illustrated. Price 21s. London: Argus South African Newspapers, Ltd., and Johannesburg: S.A. Mining Journal.

Rhodesian Mining and Engineering Year Book, 1930. Edited by S. R. POTTER and J. B. BULLOCK. Paper boards, quarto, pp. cxxviii + 312, illustrated. Price 10s. 6d. London: Argus South African Newspapers, Ltd., and Johannesburg: S.A. Mining Journal.

Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland. A record of the work done in Science, Literature and Art during 1928-29. 46th annual issue. Cloth, octavo, 413 pages. Price 18s. London: Charles Griffin and Co.

Guide to Eastern Tin Stocks, 1930. Paper covers, 102 pages. Sydney: Philip Pring and Docker.

COMPANY REPORTS

Lonely Reef Gold Mining.—This company was formed in 1910 to acquire the Lonely group claims north of Bulawayo, Rhodesia. The report for the year 1929 shows that 63,300 tons of ore was milled and 37,163 oz. gold recovered, worth £158,221, as compared with 62,330 tons, 35,030 oz. and £149,348 in 1928. Working costs were £95,813 and the working profit £62,408, equal to 19s. 8.6d. per ton, as compared with 17s. 0.8d. the year before. At the same time 181,400 tons of accumulated slimes was treated for a recovery of 12,129 oz. gold, worth £51,524, the profit from this source being £32,156 as compared with £30,003 in 1928. The total profit for the year was £98,619 and £72,324 was distributed as dividends, equal to 25%. The ore reserves at the end of the year were estimated to be 72,961 tons averaging 15.93 dwt., a decrease of 23,254 tons in amount and an increase of 0.74 dwt. in value when compared with the previous year.

Associated Tin Mines of Nigeria.—This company was formed in 1926 to work alluvial tin properties in Nigeria. The report for the year 1929 shows that during the year 3,062 tons of tin concentrates was recovered and realized on an average £142 9s. 11d. per ton. The average working cost was £82 8s. 3d. per ton as compared with £94 5s. per ton for the period of the last report. The net profit for the year was £98,527 which was carried forward. Extensive prospecting work during the year added 6,140 tons of ore to the reserves, the total reserves at the end of the year being 22,125 tons as compared with 19,000 tons at the end of the previous year.

Boulder Perseverance.—This company was formed in 1923 as a reconstruction of Great Boulder Perseverance, which was formed in 1895 to work a gold mine at Kalgoolie, Western Australia. During 1929 the financial year was altered to end on December 31 instead of September 30 and the report for the fifteen months ended December 31 last shows that 75,134 tons of the company's ore, 6,139 tons of tributer's ore, and 6,200 tons of ore from outside sources was sent to the mill. The total was 87,473 tons which averaged 12.53 dwt. gold per ton and yielded 52,787 oz. gold and 10,787 oz. silver worth together £224,355. The working profit was £10,796, but heavy expenditure on development and drilling during the year resulted in a loss of £801, to which had to be added other expenditure making a final debit balance of £2,638. The further investigation of details for the proposed new bromo-cyanide plant has been continued with convincing results.

Tekka-Taiping.—This company was formed in 1919 to work alluvial tin property in the State of Perak, F.M.S. The report for the year ended October 31, 1929, shows that during the year 1,763,500 cu. yd. of ground was treated, the output from No. 1 dredge being 212½ tons and from No. 2 dredge 320½ tons, a total of 533 tons, or 31 tons below the output for the previous year. The total revenue was £67,275 and the working profit £32,635. The profit for the year was £29,651, after writing off £7,000 for depreciation on machinery and plant, and dividends totalling 1s. 9d. per share were paid, amounting to £34,998.

Pengkalen.—This company was formed in 1907 to work alluvial tin property in the F.M.S. During 1919 the present area worked in the Kinta district was acquired and this has been increased from time

to time. The report for the year ended September 30, 1929, shows that the output from No. 1 dredge was 378½ tons, and that from No. 2 dredge 467½ tons, a total of 845½ tons from the treatment of 2,502,270 cu. yd. of ground. The year under review is the first complete year for dredge No. 2. The total revenue was £150,936, and the working profit £90,496. The net profit, after providing £15,000 for depreciation on machinery and plant, was £72,819, and dividends at the rate of 50% on the preferred ordinary shares, and 40% on the ordinary shares absorbed £71,000. During the current year No. 1 dredge will cross the Kinta River and Government road to reach the Southern section of the property.

Siamese Tin.—This company, which works alluvial tin property at Ngow, in the Renong district of Siam, was formed in 1906. The report for the year 1929 shows that 3,394,700 cu. yd. of ground was treated on the Ngow property for the recovery of 970 tons of tin concentrate, as compared with 507 tons the year before. On the Kopah properties 2,939,513 cu. yd. was treated to recover 691½ tons of tin concentrate which compares with 642 tons in 1928. Sales of ore from the Ngow and Kopah properties brought in £235,730, as compared with £180,402 in 1928, and the net profit for the year was £51,813. Dividends absorbed £45,000 as compared with £30,000 in 1928.

Bangrin Tin Dredging.—This company, a subsidiary of the Siamese Tin Syndicate, works alluvial tin ground near the property of the latter. Three dredges are now working on the property and their total output for 1929 was 699 tons of tin concentrates, the ground treated averaging 0.58 lb. per cu. yd. The revenue from the sales of ore was £98,155 and the net profit £11,451 which was carried forward.

Oriental Consolidated Mining.—This company was formed in 1897 to work gold mining property in North-Western Korea. The report for 1929 shows that during the year 232,046 tons of ore was milled, 6,774 tons less than in 1928. The total receipts for the year were \$1,041,811, and the working profit was \$281,748. After deducting reserves, the net profit for the year was \$420. The estimated ore reserves at the end of 1929 were 365,000 tons, having a gross value of \$1,990,090, as compared with 393,000 tons valued at \$1,864,461 at the end of 1928.

Oroville Dredging.—This company was formed in 1909 and holds a controlling interest in Pato Mines (Colombia), Ltd. The report for the year ended September 30, 1929, states that during that period the dredges of the Pato Mines treated 3,405,106 cu. yd. for gold valued at \$631,774. A dividend of 1s. 3d. per share was paid to Oroville shareholders, the balance carried forward being £44,173.

Peña Copper Mines.—This company was formed in 1900 and works copper properties in the Huelva district, Spain. The report for the year 1929 shows that 120,999 tons of ore was mined as compared with 101,136 tons during 1928. The ore won was mainly added to the leaching dumps, 110,757 tons being treated in this way, the remaining 10,242 being exported. During the year 824 tons of cement copper were produced, as compared with 765 tons the year before. The net profit on the year's working was £29,976 of which £10,416 was distributed as dividends, equal to 7½%.

Fabulosa Mines Consolidated.—This company was formed in Bolivia in 1921 to work a group of

tin mines. The report for the year ended December 31 last shows the output of tin concentrates during the year to be 41,681 quintals of 46 kilos, with an average cost of Bs. 44.12 per quintal placed at the mines as against 33,158 quintals and a cost of Bs. 54.80 per quintal in 1928. The net loss of the company has been reduced from £15,440 to £3,635. The position at the mines is much improved, the properties now being well developed and equipped out of operating profits. The developed ore reserves now total 131,405 tons averaging 2.5% tin.

DIVIDENDS DECLARED

Amalgamated Mining.—6d., less tax, payable June 12.

Billiton Tin.—35%, less tax.

Camp Bird.—Pref. 4%, free of tax, payable July 1.

Central Mining.—12s., tax free, payable May 29.

Chinese Engineering and Mining.—1s., less tax, payable May 30.

Esperanza Copper and Sulphur.—7%, less tax, payable June 30.

Hodbarrow Mining.—5s., less tax.

International Nickel.—25 cents, less tax.

Jelapang Tin Dredging.—6d., less tax, payable June 30.

Kaduna Prospectors.—3d., less tax.

Kaduna Syndicate.—6d., less tax.

Kramat Pulai.—1s., less tax, payable June 5.

Lonely Reef.—2s., less tax, payable July 31.

Malayan Tin Dredging.—4½d., less tax, payable June 7.

Marmajito Mines.—Pref. 2s., Ord. 6d., less tax, payable June.

North Broken Hill.—1s. 6d., less tax, payable June 30.

Santa Gertrudis.—1s. 6d., less tax, payable July 10.

Southern Malayan Tin Dredging.—3d., less tax, payable June 6.

Southern Perak Dredging.—9d., less tax, payable June 5.

Tekka.—4½d., less tax, payable June 4.

NEW COMPANIES REGISTERED

Camden Mines.—Registered May 28. Capital: £100 in 5s. shares. Objects: To acquire undertaking of Roper River Land and Minerals Co., etc. Office: 20, Copthall Avenue, E.C. 2.

Diamond Corporation.—Particulars filed May 15. Capital: £2,500,000 in £1 shares. Objects: The company was incorporated in the Union of South Africa on February 18, 1930, to carry on the business of diamond merchants in all its branches. Directors: Friedrich H. Hirschhorn, Robert F. Philipson-Stow, Sir Ernest Oppenheimer, Sir David Harris, Solomon Barnato Joel, Jack Barnato Joel, Louis Oppenheimer, and Walter Dunkels.

Rotary Smelting.—Registered as a private company May 29. Nominal Capital: £40,000 (39,500 £1 Preference and 10,000 of 1s. Deferred). Objects: To adopt agreements (1) with A. Bonnin and the Basset Iron and Steel (Parent) Company, and (2) with the said A. Bonnin; to acquire patents and inventions and to manufacture and deal in machinery. Office: 9, Great St. Helens, E.C. 3.

Urgerica Syndicate.—Registered as a private company. Capital: £1,000 in 1s. shares. Objects: To acquire radium and other mining rights and concessions in Portugal and elsewhere.

COMPANY MEETINGS AND REPORTS SECTION

CENTRAL MINING AND INVESTMENT CORPORATION, LTD.

Directors : Sir R. S. Holland (*Chairman*), R. W. Ffennell, F. Heim, O. Homberg, J. Martin, F. R. Phillips, Lieut.-Col. S. H. Pollen, A. W. Rogers, M. de Verneuil, Sir Evelyn Wallers. *Consulting Engineer* : A. J. Brett. *Consulting Engineers in South Africa* : J. E. Healey and R. S. G. Stokes. *Secretary* : R. A. Macqueen. *Head Office* : 1, London Wall Buildings, E.C. 2. *South African Office* : The Corner House, Johannesburg. *Formed* 1905. *Capital* : £3,400,000 in £8 shares.

Business : Finance of and investment in mining and other ventures in various parts of the world.

The twenty-fifth ordinary general meeting of the Central Mining and Investment Corporation, Ltd., was held on May 28, 1930, at No. 1, London-wall Buildings, E.C. 2, Sir R. Sothorn Holland (Chairman of the corporation), presiding.

The Chairman, in moving the adoption of the report and accounts for the year 1929, referred to the illnesses of Sir Evelyn Wallers and Sir Frederick Eckstein and then said :

Gentlemen, I presume that it is your wish to follow the usual course of taking the report and accounts as read. The accounts for the year 1929 have been made up in accordance with the provisions of the new Companies Act, and the balance-sheet differs from previous ones in setting out separately your interests in companies which, in the definition of the new law, fall under the category of subsidiary companies. It may be convenient to refer to them first, although our major interests are in what I might describe as associated companies. In South Africa two of our companies are subsidiary companies—namely, the Transvaal Lands and Mines Proprietary Syndicate, Ltd., and Town Properties, Ltd. The assets of the former are about £68,000 in cash, and only some £300 represent certain mineral rights. The assets of Town Properties consist of about £29,000 in cash and £14,000 in house property and real estate conservatively valued. The loss of £702 5s. 2d. by a subsidiary company disclosed in the balance-sheet refers to this company.

The head office accounts deal with three more subsidiaries : London Wall Estate, Ltd., Messrs. Bernhard Scholle and Co., Ltd., and the Anglo-Spanish Construction Company, Ltd. The London Wall Estate owns London Wall Buildings, in which, together with a considerable number of other tenants, we are suitably housed on satisfactory terms of lease. We hold debentures and the majority of the Ordinary shares, both of which are sound and valuable securities. The shares yield a good return, which, moreover, is expected to rise considerably in a few years' time after complete redemption of the Second Debentures.

We do not own a majority in the share capital of Bernard Scholle and Co., but our voting rights bring that firm within the definition of a subsidiary company under the Act. In the Anglo-Spanish Construction Company we hold debentures and shares, and, in addition, have made the advance of £1,445,000 referred to in the balance-sheet repayable from the company's assets in Spain. I shall refer to both companies when dealing in detail with our various interests.

The transfer of our holdings in subsidiary

companies to separate headings naturally affects the comparison with previous years. The change to be noted on the debit side of the balance-sheet is the reduction of our liabilities by £982,000. On the assets side, fixed-interest-bearing securities show a decrease of £1,234,000 and an increase in other investments of £794,000. This increase is spread over a very large number of items. In gold mines we have added, among others, to our holding in Rand Mines, Crown Mines, and New Modders. In Oil shares we have considerably increased our investments in all the companies under our administration, while the interest taken in Bolivia, referred to in the report, and minor acquisitions in Northern Rhodesia account for the heading "Base metals." The total of debtors, loans and cash is down by about £542,000.

To recapitulate shortly :—

Decrease of liabilities	£982,000
Plus increase of investments	794,000
together	£1,776,000

Accounted for by :—

Decrease of fixed-interest-bearing securities and reduction of cash assets	£1,234,000
making	542,000
	£1,776,000

The addition to what may be called our permanent investments has been on a larger scale than for some years, and, while reducing to some extent our liquid resources, a sound position is maintained.

The profit and loss account shows a credit balance of £668,000. A slight and, I fear, only temporary reduction in general expenses, is offset by increased Dominion taxation, leaving the net profit at £563,000, compared with £725,000 in the previous year. The reduction is severe, but fluctuations in the rate of profit are unavoidable, especially in these times. The result enables us to maintain the rate of dividend and bonus to which you have become accustomed for some years past. We recommend a final distribution of 8s. dividend and 4s. bonus, making a total of 20s. for the year, free of income-tax. For the first time for a number of years, we are unable to recommend an allocation to the reserve fund, which, however, remains at the substantial figure of £1,900,000.

The period covered by the accounts has been a difficult one. Months of great activity, particularly in America, resulted in excessive speculation, over-production and exaggerated prices for securities and commodities. A reaction was bound to occur, and, long before the autumn, when the American boom collapsed in a spectacular fashion, our view of the situation led us to adopt a cautious attitude.

As a consequence, we were fortunate in avoiding serious losses. It was, however, a matter for regret that, while Gold and Oil shares—in which we are more particularly interested—were not favoured by the public during the active period, in the subsequent general decline their prices also gave way. The fall afforded us, as already stated, the opportunity of adding to some of our holdings at attractive prices, but considerable depreciation—affecting not only our holdings in Mining and Oil shares, but also gilt-edged securities; in fact, the whole of our large portfolio—had to be met at the end of the year. After a careful revaluation of our holdings, I am glad to be able to say that the value of our investments at market prices on December 31 last was considerably in excess of book prices. Since the beginning of the year there has been a satisfactory appreciation in a great many stocks.

It is gratifying to record that our income from the regular sources of revenue of our business was highly satisfactory. The result shown on balance has not benefited to any extent from casual profits. Taking all the circumstances into consideration, I feel that you will not be dissatisfied with the results achieved during a difficult period.

During 1929 the South African producers forwarded their gold for treatment to the Rand refinery as in previous years, and the realization was effected on similar lines to those in 1928.

The details of disposal are as follows:—

10,227,037 fine oz. valued at	£43,377,745
were sold to the Reserve Bank locally under the agreement.	
585,445 fine oz. valued at	2,484,482
were sold in London to India, of which	
517,419 oz. were shipped from Durban to Bombay, and 68,026 oz. from Durban to Madras, making a total of:—	
10,812,482 fine oz. valued at	£45,862,227

The average selling price obtained for the total production was, therefore, 84s. 9-984d., from which have to be deducted the expenses on bullion railed to Durban. The average price for 1928 was 84s. 9-828d. The sterling-dollar exchange during 1929 did not favour exports of gold from America to India, and hence there was no necessity to adjust the f.o.b. Durban price, which remained at 84s. 10½d. per fine ounce throughout the year. In addition to the producers' bullion shipments to India, about 3½ million sovereigns were imported into that country by the South African commercial banks; furthermore, consignments of over 1½ million sovereigns were made on competitive terms during 1929 from Australia to India.

The output of silver in the Transvaal Province during 1929 amounted to 1,031,779 fine oz., of which 694,091 oz. were shipped to India by the Rand refinery, and the balance was sold to the Royal Mint, Pretoria.

The South African gold mines under the administration of the Central Mining-Rand Mines group again experienced a satisfactory year, the results for the period under review being very similar to those of 1928, though there was a slight decrease in average working revenue. There were several noticeable features in the year's operations. An average reduction of a little over 6d. per ton milled was effected in working costs, due in a considerable measure to a reduction in the cost of stores con-

sumed; a further marked improvement was recorded in machine efficiency for development work, the average advance per machine shift being increased from 1-98 ft. in 1928 to 2-12 ft. during 1929, while the cost per foot advanced was reduced by 2s. 2d.; a record fathomage was again broken in stopes and the jackhammer efficiency was more than maintained; shovelling and trammimg efficiency increased during the year from 1-72 tons per native to 1-85 tons. On the metallurgical side, the average reduction costs were reduced by 1-4d. per ton milled, while the average residue was practically the same as during 1928. But for the considerable increase in the residue at the Modderfontein East mine, due to the plant being taxed beyond its capacity, there would have been an appreciable improvement in the latter figure. In this connexion the additions being made to the reduction plant are nearing completion.

I mention the above facts to show that the work carried on by the investigations committee is being actively pursued and is being attended by valuable results. It is interesting to record that the use of mechanical appliances in handling broken ore is proving very effective on the flat dip mines of the Far East Rand, and they are being installed as rapidly as conditions permit. They have not been found, however, to be economical on the steep dip of the Central Rand. I might also mention that during the year an investigation was made within the group into the methods of control, training and payment of natives, and, subsequently, a report was issued to all the mines under our administration with the object of initiating a vigorous campaign to increase native efficiency and improve the existing methods of training "boss boys." This has already proved of definite value, especially in extending the application of piece work to lashing and trammimg boys, which has proved very popular with them.

The question of an adequate supply of native labour for the mines has continued to engage the attention of the industry. During the first three months of 1929 the supply increased from 187,970 at the end of 1928 to 197,646 at the end of March. From this date the supply declined month by month, until at the end of December, 1929, there were only 184,280 natives in employment. In the current year there has been some improvement in the figures, though they are still below the figure of 206,000 estimated to be the number required for the full operating capacity of the mines' existing plant.

I should like to digress here for one moment to refer to the impression I gathered on my recent visit to South Africa. I was greatly disturbed to find, in spite of so many warnings from those responsible for the management of the mining industry, what little thought or concern was being given to the problem which South Africa will have to face of the steady contraction and final disappearance of the great gold mining industry, on which the prosperity of the country has rested for so long a period of time.

Let us glance at conditions in the world at large to-day. It is suffering from an actual glut of commodities—wool, grain, cotton, artificial silk, diamonds, copper, platinum, tin, rubber, nitrates, oil—in fact, almost the whole range

of minerals, agricultural and other products—while gold, on the other hand, is wanted in greater and greater quantities. There is no limit to its market; it is not subject to economic depression, to fashion, or to a surfeit of production, and always commands a standard price. In the period of depression through which the Union of South Africa, in common with other countries, is now passing, the gold mining industry is the one stable factor. The prosperity of the Union is founded on its gold mines (though this fact has tended to become obscured by the development of manufacturing and other activities which have grown up in order to satisfy demands created largely by the mines themselves), and South Africa will continue to be dependent on the steady flow of wealth which the mines contribute. The future of the mining industry is, therefore, of the greatest importance to the country, and any contraction in its operations must react on the economic welfare of the Union as a whole.

I even found that the belief was held that the mining of platinum ore will in the near future expand so rapidly that it will largely take the place of a diminishing gold industry. This is a fallacy, which can be clearly seen by a glance at the statistics in regard to platinum. I think it may be accepted that a figure of about 200,000 oz. represents the annual world consumption of new platinum, and that the average price during 1929 was between £13 and £14 per ounce, and is now much lower. It has been suggested that at a price of, say, £9 an ounce, consumption might expand to some 300,000 oz. annually.

To take the best case for the platinum producers of the Union, if one assumed that new users could be found for the metal at this lower price and that consumption could be stimulated to, say, 400,000 oz. per annum, and if South Africa supplied the whole of this amount it would derive a revenue of some £3,600,000 only, which is actually slightly less than the value of the output of the Crown Mines. To produce such an amount of platinum from the Rustenburg district, provided the average contents of the ore so far developed persist, would require the crushing and treatment of less than 2,000,000 tons per annum. This tonnage would be considerably less than that of the Crown Mines, and would probably serve to employ some 1,000 white men and 10,000 natives, while the costs of the plant employed and stores used would certainly be less than half those necessary for the equipment and running of a gold mine, such as the one mentioned. While I would urge that every encouragement should be given to increase the scale of platinum production, in the development of which industry, I may say, we ourselves are interested, I think it is as well that the position should be clearly understood in order that lack of knowledge and appreciation of fact may not give rise to false hopes.

Now, as regards the gold mines of the Witwatersrand, there are immense tonnages of low-grade ore, and such tonnages are to be found not only in the so-called low-grade mines, which are responsible for 60% of the total ore mined, but also in the richer mines of the far East Rand. A reduction of costs would have the effect of lengthening the lives of all the mines, rich or poor. A mine, which has once been closed down, whose workings have been

abandoned and whose plant and machinery have been dispersed, can rarely be profitably reopened. Certain mines to-day are on the border-line of payability, and under existing conditions must cease operations in the comparatively near future. The problem is thus one of immediate importance, one for consideration and settlement to-day and one which cannot safely be deferred.

Gentlemen, I feel it should surely not be beyond the bounds of human ingenuity to devise the necessary means. By the sacrifice on the part of the Government of some revenue to-day, by a modification of the colour bar restrictions, and by other measures to be sought for by those in authority in collaboration with the responsible leaders of the industry, it undoubtedly should be possible to bring about a reduction of working costs to an extent that will ensure the incorporation of the large bodies of low-grade ore into the region of payability and thus ensure a continuance of the prosperity of the Union for a considerable time to come. Failure to take timely measures to this end will result in a collapse which the country will find it difficult to face.

I speak as a South African deeply concerned in the future welfare of the Union, and as one having a full consciousness of the dangers that must inevitably befall the country if supineness or present political considerations, result in a policy of *laissez-faire* and the inevitable closing down of mine after mine as their present payable ore reserves become worked out. It is a question on which all parties might agree to co-operate in order to work out a national policy to prolong the life of this great source of wealth so important to the Government and to every individual living within the Union.

During December, 1929, negotiations between Village Deep, Ltd., and the Robinson Deep, Ltd., which had been proceeding for some time, had advanced sufficiently far for a provisional agreement to be entered into for the sale of the company's undermining rights and certain plant and equipment. Since the close of the year this agreement has been ratified by the shareholders of both companies and approved by the Union Government. As you are aware, this mine has reached a very great depth; it is the deepest working mine in the world. With its single main hoisting shaft, the difficulties of ventilation and efficient working at great depth, and with its inadequate ore reserves, the margin of working profit was necessarily small. The directors of the company, therefore, had little hesitation in recommending agreement to the proposed sale to its neighbouring company, by which mining operations could be carried on with greater facility, and the acceptance of a cash offer which was based on past working results and was calculated to amount to a present value of fourteen half-yearly dividends of 2½% each.

The capital of Durban Deep, Ltd., was recently reconstructed. After cancelling 10,000 unissued shares and 15,912 ex-enemy shares, the nominal value of 424,358 £1 shares was reduced to 10s. per share. 325,642 new shares of 10s. each were created and offered to shareholders. This issue was underwritten jointly by the corporation and the Rand Mines and received a gratifying response from shareholders considering the unfavourable

market conditions. The total capital of the company will, therefore, now be £375,000, in 750,000 shares of 10s. each. The additional funds have been provided for the purpose of enlarging the reduction plant and of liquidating the outstanding debentures and loan indebtedness. The future prospects of the company appear favourable, and, barring unforeseen circumstances, it is hoped that dividend payments will be resumed in the current year.

A record tonnage of 2,643,000 was milled at the Crown Mines, in spite of native labour shortage during the greater part of the year. The profit at £947,000 was slightly less than that of the previous year on account of a fractional decline in the yield. The available ore reserves were increased by nearly 100,000 tons, and the value was maintained at 6.4 dwt. Certain additions to the reduction plant were recently completed, and the capacity of the three mills is now 245,000 tons a month. During one month a record tonnage of 240,000 was milled.

Since the close of the year, the company has acquired 2,084 morgen of the farm Diepkloof, together with a mynpacht thereon, situated on its south-western boundary. The Consolidated Main Reef Mines have purchased from the company that portion of the mynpacht which adjoins the southern boundary of their property. The company's No. 17 vertical shaft is located about 500 ft. north of the Diepkloof mynpacht, and from this shaft the new area will be developed. The consideration given for the farm is 40,000 shares of the company, and to meet this payment it is proposed to issue the whole of the ex-enemy shares, totalling 34,087, held by the company, and the balance out of shares in reserve. The acquisition of this additional ground will naturally give increased length to the life of the mine, whose general lay-out places it in as favourable a position as possible to work at great depth.

New records were established by the New Modderfontein mine during the year ended June 30, 1929. The tonnage crushed at 1,713,000 tons exceeded that of the previous year by 87,000 tons. The working profit at £2,252,000 was greater by over £10,000. Development footage was increased from 58,565 ft. to 74,982 ft., with gratifying results. The ore reserves at 7,857,600 tons of 8.9 dwt. show a slight decline in tonnage and value. The prospects for the current year are favourable, and our confidence in the future prosperity of the mine remains unabated.

As I pointed out to you last year and the year before, the City Deep mine has been going through a lengthy period of drastic underground reorganization, rendered necessary by the serious and steady decline of the grade of ore developed and percentage of payability. During the year 1929, an increased operating loss was shown in spite of an increased tonnage milled and a reduction in working costs of 1s. 11d. per ton. I am glad to say that the strenuous efforts of the management at last appear to be reaping their reward, and in this connexion I cannot speak too highly of the work performed by those responsible for the management of this mine. During the quarter ended March 31 of this year working costs were reduced to an average of 22s. 9d. per ton milled, as compared with

25s. 10d. for 1929 and 27s. 9d. for 1928. The working loss for the quarter was greatly reduced.

I cannot do better than quote the opinion of the consulting engineer as to the present position and prospects of the mine: "The outlook at the mine to-day is better than it has been during the past two years. More stable working conditions have been established and costs satisfactorily reduced. The prospects are favourable, with adequate labour, for the maintenance of a mill tonnage approximating plant capacity, and some improvement in the results of future development may be reasonably anticipated. At the same time, in view of the difficulties and heavy fixed charges inevitable with mining at great depth, only small profits can be expected without considerable improvement in the grade of ore available for stoping."

Before passing from our South African interests, I wish to pay a tribute to the splendid work of our colleague, Mr. John Martin, who represents us with such distinction and ability in that country. In addition to his other important duties, he has just concluded a most successful term of office as President of the Chamber of Mines.

Turning to our oil interests, the results of Trinidad Leaseholds, Ltd., for the year ended June 30 last were very satisfactory, and a dividend of 30% was distributed. For ten months of the current financial year production and purchases of that company amount to 793,100 tons, being an increase of 63,450 tons compared with the same period last year. The extensive capital programme on which the company embarked some years ago for the modernization of refineries and field equipment is now almost completed, and the company will in the near future derive the full benefit of these important improvements. Despite the increased tonnage handled, the revenue for the current financial year shows a considerable falling-off, due to the unsatisfactory prices which have prevailed since August last, and as a result the interim dividend has been reduced from 12½% to 7½%. World over-production of crude oil, which is entirely responsible for the low prices of products, has for a considerable time past received the close attention of all important oil interests, and the success of their concerted action is reflected in the substantial reduction of approximately 400,000 barrels per day in the United States production from the peak figure reached at the end of August, 1929. Recently oil prices have shown a tendency to harden, which is a further hopeful sign of success in the efforts which have been made to reduce production to a figure more nearly approximating consumption.

A new company, called Siparia Trinidad Oilfields, Ltd., with an authorized capital of £500,000, is about to be formed to acquire the freehold land and oil rights of the Venezuelan Consolidated Oilfields, Ltd., in the Palo Seco district in Trinidad, together with Government oil rights to be granted over 4,000 acres in the Siparia district. Development results in the Palo Seco area are distinctly promising, and since January last an average production of approximately 4,000 tons per month of high-grade oil has been secured. The Siparia area is considered to possess good prospects. Trinidad Leaseholds, Ltd., has secured a con-

trolling interest in the new company and has in turn ceded participations to our corporation and to Rand Mines, Ltd.

Our corporation and the other interested parties have continued to finance the operations of the North Venezuelan Petroleum Company, Ltd., the issued capital of which to-day stands at £740,000. Unfortunately, drilling operations at Aguide have not, so far, been successful, but in the light of the experience gained from the two wells already drilled, further test drilling is about to be undertaken. Geological operations throughout the concession are being vigorously pursued and are now augmented by very active geophysical investigations which we believe may lead to important results.

I am pleased to tell you that the progress made by the Tocuyo Oilfields of Venezuela, Ltd., has been very satisfactory. When the company was floated in October, 1928, it was not anticipated that the revenue-earning stage would be reached for about two years. It is, therefore, all the more gratifying, and a testimony to the energy and efficiency with which operations have been carried on by the general manager and all members of the staff, that the company will be shipping its first consignment of oil within the next few weeks. A pipeline approximately 20 miles in length from the field to the shipping port was recently completed, together with the necessary tankage and loading facilities. The programme of test drilling has been continued with satisfactory results.

As I indicated would be the case, when referring last year to our railway interests in Spain, the whole of the line from Calatayud to Ciudad, a distance of approximately 366 kilometres, is now very near completion. Towards the end of last year the two sections—namely, Soria to Calatayud southwards and Peñahorada to Trespaderne northwards, totalling 144 kilometres—were put into exploitation. The remaining portion from Trespaderne to Ciudad should be finished next month or the month following, when the work of construction and equipment of this railway as at present defined by the Spanish Government will have been completed by the Santander-Mediterraneo Railway Company.

As regards the section which in the future may be built from Ciudad northwards, the Government last August intimated their decision of a change of route, and gave instructions to the proper authorities for the preparation of a survey to Renedo, where the line would link up with the Norte Railway to Santander. This survey, we understand, has not yet been completed, but you will remember that in the terms of the Royal Decree of 1927, under which the Santander-Mediterraneo Railway Company has carried out its work, it was provided that, should the Government wish to vary the route, the Santander-Mediterraneo Railway Company would not be called upon to construct that portion of the line if the distance or cost of the proposed new route were greater than the original plan. The position, therefore, in this connexion is uncertain, as, in addition to this fact, the Government now in power has stated in its policy of economic reform that it is unlikely that any new works of this nature will be undertaken at present.

Thus it seems clear to us, as regards this particular section of line, that the route to be taken, the time when the work is to be carried out, and the conditions and terms on which it will be carried out are deferred indefinitely, and will call for consideration anew.

The construction work and general operations under the general manager and those associated with him have been pushed throughout the year with great ability and judgment, and our regular visits to the line have confirmed our confidence in this aspect of the enterprise. First-class work has been done expeditiously and efficiently and at a cost in accord with the estimate framed for the construction and equipment of the line Calatayud-Cidad.

For the two completed sections put into exploitation towards the end of last year, the payment due from the Government to the Santander-Mediterraneo Railway Company was approximately 95,000,000 pesetas. This amount has been confirmed by the Government, and payment of 25,000,000 pesetas has been received on that account. The balance remaining of 70,000,000 pesetas should be settled in the course of the next few months, and in the meantime interest accrues at the rate of 5% per annum.

The method of financing this enterprise has been referred to before by me, but it may be well just to repeat that we have made advances to the Anglo-Spanish Construction Company, Ltd., who, in turn, have financed the Santander-Mediterraneo Railway Company with such sums as have been necessary to complete the work. A portion of the last payment received in Madrid by the Anglo-Spanish Construction Company from the Santander Mediterraneo Company on account of partial refund of loan has remained on deposit in Madrid, it being, in our opinion, undesirable at the present time to incur the loss that would be sustained by transferring funds to London at the depreciated rate of exchange as ruling to-day. And while these conditions prevail, I fear it will be necessary to carry out the same procedure in regard to the balance of 70,000,000 pesetas that should be paid by the Government in the course of the next few months.

Recent political events in Spain, coincident with a heavy depreciation in the country's exchange, have naturally caused us considerable anxiety. As you know, the dictatorship which had prevailed for the last six years was abolished last January, and a provisional Government was appointed with the intention of bridging over the period until Constitutional Government is resumed. The present Government commands respect and is pursuing steadily a policy of economy and the restoration of confidence, but the political situation of necessity appears at present somewhat confused and uncertain. I have referred to the political situation because it will be clearly realized that the governing factor in this important industrial interest of ours at this juncture is the matter of the country's rate of exchange. The position is naturally not free from anxiety, and we have endeavoured to obtain from those qualified to express an opinion the probable reason for the present depreciation in Spanish currency, and the

course the exchange is likely to follow. We are unable to find in the existing Spanish financial and industrial conditions any justification for the depreciation. Trade, broadly speaking, has remained on fairly steady lines; the adverse visible balance of trade has, similarly, remained steady, and there has been no appreciable currency inflation. In seeking a reason, therefore, one can find it only in the fact that a period of political uncertainty has prevailed in Spain for some time past, and that operations in pesetas, both on capital account and for speculation, may have been coincident with that uncertainty. I feel that there is reasonable ground for believing in an appreciation of the peseta if the present Government is able to develop a steadiness in the general political situation, pursue its policy of national economy, and thus enable the great financial strength possessed by the country and the Bank of Spain to function effectively.

Both the profits and the balance sheet totals of Bernhard Scholle and Co., Ltd., were smaller than those of the previous year. This was the natural outcome of the reaction in trade; the world-wide contraction of business and the heavy decline in security prices which were the outstanding features of 1929. Dividends were paid at the same rate which has obtained in the past, and a small addition was made to the carry-forward.

As regards the British Metal Corporation, Ltd., it was decided early this year to amalgamate the interests of that corporation with those of Messrs. Henry Gardner and Co., which has in the past carried on business of a similar nature in many parts of the world. The advantages of such a fusion of interests under present-day conditions will be apparent. Our holding in shares of the British Metal Corporation has been exchanged for shares in the new company, the Amalgamated Metal Corporation, Ltd., and, representing as it does an amalgamation of two of the most important and successful metal enterprises in this country, the future of that corporation can be regarded with confidence.

You will have been interested to see from the directors' and the consulting engineer's reports that we have acquired an interest in two tin companies in Bolivia, following a favourable report made to us by Dr. Malcolm Maclaren. Associated with us in the business are French friends, the Société Alsacienne & Lorraine de Recherches Minières and Messrs. Mauricio Hochschild & Cia, Ltda., of Valparaiso, an important firm operating in South America, which has a large experience of metal business. I am glad to be able to inform you that one of our mining engineers from the Rand has been appointed general manager of the companies. He arrived on the properties last month, and is now engaged in preparing a comprehensive development and mining programme. With the modernization of mining and metallurgical methods, and the benefit of experienced management, the prospects of satisfactory returns on our investment appear promising.

Lastly, you will have seen recently that the corporation have become shareholders in the Bankers' Industrial Development Company, a company formed under the ægis of the Bank of

England to assist and finance the reorganization of groups of British companies engaged in important industries.

Now, gentlemen, that completes my review of our affairs. Our annual meetings afford the opportunity of giving you a general survey of the enterprises and operations in which we are engaged in many parts of the world, and in covering this wide field I consider it my duty neither to stress nor to minimize the difficulties which we encounter. We have had a difficult year, and, looking ahead, conditions are not encouraging. The world is at present passing through a phase in which supply exceeds demand, and the effects are felt the more acutely because this condition extends to almost every country and covers almost every commodity. Neither capital nor labour has escaped the consequences. I can only express the hope that before we meet again an improvement will have been effected in the general condition of affairs, and that we may share in the benefits of such improvement.

In conclusion, it is my privilege to testify to the loyalty and efficiency with which all officials and members of the staff, not only of this corporation, but also of the various enterprises in which we are interested, have discharged the duties assigned to them. As I have said, during the early part of this year I paid a visit to South Africa, with the object of making an inspection of all our mining and other industrial undertakings, and I made a special point of getting into close touch with the personnel of our organization. I cannot speak in terms of too high praise of the splendid body of workers that serve our interests in that country, and of the great efficiency which characterizes their work. I firmly believe that it would be impossible to find a more expert, competent, and loyal body of mining and industrial managers and men in any part of the world. (Hear, hear.) Your interests are in good and capable hands. I am sure that shareholders will wish to be associated with the Board in assuring all those directly or indirectly in the service of the corporation of our appreciation of their continued efforts to promote its success and welfare.

I now beg to move: "That the report and accounts for the year ended December 31, 1929, as printed and circulated among the shareholders, be and they hereby are received, approved and adopted; and that the payment of a final dividend of 8s. per share and a bonus of 4s. per share, both free of income-tax, to shareholders registered on the books of the company at the close of business on May 20, 1930, and to holders of Coupon No. 36 attached to share warrants, in respect of the year ended December 31, 1929, be and the same is hereby sanctioned."

Mr. F. Heim seconded the resolution, and no questions being asked, the resolution was put to the meeting and carried unanimously.

The Chairman: I beg to announce that the dividend warrants will be posted this evening and will be payable to-morrow, May 29.

Mr. F. R. Phillips proposed the re-election of Sir R. Sothern Holland and Mr. F. Heim, the retiring directors.

Lieut.-Col. S. H. Pollen seconded the motion, which was unanimously adopted.

RAND MINES, LTD.

(Incorporated in the Union of South Africa.)

Directors : J. Martin (*Chairman*), F. Raleigh (*Managing Director*), Sir Evelyn Wallers, W. H. A. Lawrence, W. Mosenthal, F. G. C. E. Robellaz, J. L. Jourdan, C. L. Read. *Manager and Secretary* : S. C. Steil. *London Secretaries* : A. Moir and Co. *Head Office* : The Corner House, Johannesburg. *London Office* : 1, London Wall Buildings, E.C. 2. *Formed* 1893. *Capital issued* : £531,498 15s. in 5s. shares. *Business* : Finance of and investment in mining and other ventures, particularly in deep-level mines on the Rand.

REPORT OF THE PROCEEDINGS

At the Thirty-fifth Ordinary General Meeting held in Johannesburg on May 5, 1930.

The Chairman (Mr. J. Martin) said : Gentlemen, the Report and Accounts include the usual summary showing the results achieved by the Witwatersrand Gold Mining Companies of the Central Mining-Rand Mines Group for that period. From the Profit and Loss Account it will be seen that the profit for the year under review amounted to £545,570 compared with £526,190 for the previous year. Dividends on shareholdings at £486,532 showed an improvement of £67,202, while the revenue from Reservoirs and Sundry Sources was reduced by £31,334. Realization of Investments again took place on a small scale only. As in the previous year, two dividends of 50% each, absorbing a total of £511,287, were declared. As will be gathered from the Balance Sheet and Accounts, the Company again had a successful year, earning an increased profit, paying 100% in dividends and maintaining a strong and stable financial position, results which are all the more satisfactory in view of the fact that in the latter part of 1929, and subsequently, financial and industrial conditions in many parts of the world showed a serious reaction, from some of the effects of which few business enterprises have escaped. It is of interest to note that, allowing for the dividends paid last year, the Rand Mines, Ltd., has, since the inception of the Company in 1894, distributed over £20,000,000 to shareholders, and the current dividend rate of 100% per annum has been maintained since 1925. These figures represent a gratifying record of successful operations and of financial stability.

The Witwatersrand gold mining companies of the Central Mining/Rand Mines Group were during the past year reduced in number owing to the closing down of the Ferreira Deep and the Wolhuter, whose lives were, however, protracted considerably beyond the term that had at one time been thought to be the maximum. These mines had produced gold to the value of about £30,000,000. The remaining twelve mines in 1929 milled 12,920,600 tons of ore, producing gold of a value of £17,800,000 ; the total working profits amounted to £4,369,191, or 6s. 9d. per ton milled, and the dividends declared came to £3,525,317. The production of gold by the Witwatersrand mines of the Group (including the production for part of the year of the Ferreira Deep and the Wolhuter) represented about 43% of the total gold production of the Witwatersrand and over 20% of the total gold production of the world in 1929, figures which indicate the important factor the mines of this Group are in relation not only to South African, but to world production of gold. The figures show a reduction of 6-3d. per ton milled in average working cost which represents a saving over the mines of the Group of a total of approximately £340,000 during the period under review. That this reduction should

have been achieved in face of the progressively increasing depth of workings, and while an enormous development programme is being maintained by the mines, is particularly satisfactory in itself and particularly creditable to our technical advisers, the individual managements and the organization generally. The development footage in 1929 at 502,112 feet, which was only fractionally lower than the total for 1928, represented over 45% of the total development carried out last year by the Mining Industry of the Rand. It may also be pointed out that the development footage being accomplished by the whole Industry at the present time is nearly double what it was in 1921, which must be regarded as a truly remarkable achievement. The reduction of average working costs on the mines of the Group to which I have referred took place also throughout a period when the Industry in general was handicapped and embarrassed by periodical shortages of native labour. The representations that have frequently been made by the Mining Industry for a reduction of the unduly high railway rates on coal have not met with any success. The record fathmage broken in stopes during 1929, at 1,007,565 fathoms, was 47,618 fathoms more than in 1928.

During the past year the average number of white employees in the service of the Witwatersrand mines of the Group was 9,378, and the average number of coloured and native employees was 81,171, there being in both categories very little difference in numbers compared with the averages in the previous year.

City Deep, Ltd.—Operations during 1929 were adversely affected by the inadequacy of payable ore reserves, which was the main cause of a fall of 2s. 1d. per ton milled in the working revenue and by the necessity for maintaining development operations on a large scale. There was, however, a decrease of 1s. 11d. per ton milled in working costs. The ore reserves showed a falling off of 191,900 tons with an increase in average value of 0.1 dwt. per ton. The modified system of resuing, introduced in 1928, was gradually extended with beneficial results. The position at the mine when the year closed was better than it had been during the previous two years, more stable conditions having been established and costs reduced. The prospects are favourable, with adequate labour, for the maintenance of a mill tonnage approximating plant capacity, and some improvement in the results of future development may reasonably be anticipated. At the same time, in view of the difficulties and heavy charges inevitable with mining at great depth, only small profits can be expected without considerable improvement in the grade of ore available for stoping. During the first quarter of the current year the working revenue showed a decline of 1s. 3d. per ton milled, but costs were

3s. 1d. per ton milled lower than for the year 1929, the working loss for the period being £10,702, compared with £50,327 for the corresponding quarter of 1929. The indebtedness of the Company under loan account at December 31 was £385,379 1s. 8d. As you are aware, this financial assistance is provided by The Central Mining and Investment Corporation, Ltd., and the Rand Mines, Ltd.

Consolidated Main Reef Mines & Estate, Ltd.—The working profit for the financial year ended June 30, 1929, was £27,699 lower than for the previous year, and the two dividends distributed amounted to 10%, compared with 11½%. The exploratory work on the Bird Reef gave very satisfactory results, some 287,200 tons of 5 dwt. ore being blocked out and included in the ore reserve. This favourable development provided an offset to the disappointing development on the Main Reef Series in the Western Section of the mine, and assisted towards the net increase of 143,300 tons in the available ore reserve at June 30, 1929. Working profits for the last six months of 1929 were on a lower scale, and amounted to £89,695, but permitted of the maintenance of the dividend declaration at 5%. For the first quarter of 1930 the working profit was £36,600. Since the close of the year this Company has acquired approximately 274 claims situated on the farm Diepkloof adjoining the southern boundary of the eastern section of the mine and lying to the east of the farm Klipspruit No. 8, which was acquired in October, 1927.

Crown Mines, Ltd.—Profits for the year were slightly lower than those for 1928, but the dividend rate was raised from 55% to 65%. Arising from the purchase, since December 31, 1929, of the farm Diepkloof, adjoining the southern boundary of the Mooifontein mining area, acquired in 1926, this Company has added approximately 590 intact claims to its mining area. Both the Main Reef Leader and the South Reef occur in this mine, the unworked area of which is equivalent to 2,722 intact Main Reef Leader claims and 2,937 intact South Reef claims. The average daily tonnage mined during 1929 was 9,771 tons, and the average daily production of gold was 2,752 oz. Capital expenditure during the year amounted to £207,442 and is expected to continue at a high level for the next two years, after which it is anticipated that the requirements for this purpose will be under £100,000 per annum. A total of 3,655 feet of vertical shaft sinking was done during the year, and, in addition, the development accomplished was 87,401 feet. The payable ore developed was estimated at 1,950,864 tons of an average value of 6·7 dwt. per ton. The available ore reserve at December 31, 1929, totalled 8,896,270 tons of an average value of 6·45 dwt. per ton, in addition to which there were, in the form of shaft and safety pillars, 1,945,190 developed tons of an average value of 7·63 dwt. per ton. For the first quarter of 1930 the total profit was £231,659.

Durban Roodepoort Deep, Ltd.—The position and prospects of this Company's mine have improved during the last year or two to such an extent as to warrant the reconstruction of the Company's capital, which was duly effected early in the current year, by means of which sufficient funds have been provided for the liquidation of the Company's loan indebtedness, for the immediate redemption

of its outstanding debentures and for increasing the milling capacity from 41,000 tons to 46,000 tons per month. The extensions to the reduction plant should soon be finished, but the augmented plant will not become fully effective until about the end of this year, on account of the unavoidable hanging up of stamps in connexion with the urgent work on reconditioning the mill bins. The prospects of earning improved working profits during the latter part of the current year are satisfactory, provided an adequate native labour supply is available, and the situation generally is such as to strengthen the hope that the resumption of regular dividend payments will not now be long delayed.

East Rand Proprietary Mines, Ltd.—The working revenue and profit for 1929 were higher than in any year since the disappearance of the premium on gold. Appropriation Account was strengthened by £75,843, notwithstanding the amounts charged to it for Capital Expenditure and Excess Development, which totalled £52,210. The available ore reserve increased by 127,530 tons. The development footage, which included 2,130 feet of incline shaft sinking, totalled 74,074—figures only once exceeded in the past 19 years. Progress was delayed in two of the six incline shafts being sunk, owing to their having penetrated the heavy water zone. The reorganization of the methods of handling ore has made good progress, a much larger proportion being now hoisted through the vertical shafts. The total quantity of water raised to the surface during the year exceeded 881 million gallons, in addition to which 339 million gallons were pumped underground to reservoirs for re-use in the mine. Pumping costs for the year aggregated £139,416, equivalent to 1s. 7d. per ton milled. For the first three months of 1930 the average monthly working profit was £9,953 and the development footage amounted to 18,527 feet, which included 551 feet of incline shaft sinking. Development exposures were, however, less satisfactory than those obtained in 1929. The capital expenditure for 1930 is estimated to amount to £144,204, mainly in respect of hoisting, air compressor and pumping plant, shaft and underground haulage equipment. The additional capital raised at the time of the amalgamation with the Cinderella Consolidated Mines having been exhausted, this expenditure will have to be financed from past and current profits. A proposal from the Board of the Witwatersrand Deep for the acquisition of the assets of that Company by the East Rand Proprietary Mines is now under consideration.

Modderfontein B. Gold Mines, Ltd.—The tonnage milled exceeded all previous records, the dividend rate was maintained at the same level as for the previous three years, and the financial position remained eminently sound. Ore from Upper Leaders of a grade of 4·1 dwt. constituted 12·4% of the tonnage mined, and a similar supply will continue to be derived from this source. Development, as in the previous year, was confined principally to the exploration of areas of doubtful value, the major development of the mine having been completed. The tonnage of payable ore developed in the Main Reef Leader was 286,800 tons, and the ore reserve, as re-estimated at the close of the year, showed a decrease of 294,800 tons. The substitution of mechanical scrapers for hand-shovelling has been largely extended in this mine,

the underground conditions being well adapted for their efficient use. Their employment, in conjunction with a modified shrinkage method of mining, has proved beneficial in many directions conducive to efficiency and economy. In the first quarter of 1930 the total profit amounted to £148,359.

Modderfontein East, Ltd.—The increased rate of milling established during the year ended June 30, 1929, has been well maintained during the current year to date, and a dividend of 10% was declared for the six months ended December 31 last equalling the dividends paid in respect of each of the two preceding half-years. The development accomplished during the past financial year reached the record total of 52,473 feet and enabled the available ore reserve at the end of that period to be increased by 103,300 tons to 2,045,400 tons, averaging 6.1 dwt. per ton over an estimated stoping width of 46.5 in. Most of the payable ore developed was again located in the area above the 16th level, to the north of No. 2 and No. 3 Shafts, and the drives north on the 5th, 8th, 11th, 14th, and 16th levels all continued to give disappointing results. Development is being continued at the same rate, and there is no change of any special importance to record in the tenour of its results. The extensive exploratory work in the large outer areas of the Company's property is being actively continued, in the hope of locating fresh payable zones.

New Modderfontein G.M. Company, Ltd.—The results obtained during the financial year ended June 30, 1929, were eminently satisfactory, fresh records again being achieved in the tonnage milled, the development footage accomplished and the profits earned. The amount of the dividends declared was £1,960,000 and £315,982 was paid in direct taxation. The scale of development was increased, larger footages being driven on the South Reef and on the Upper Leaders, where the values encountered were again satisfactory. As the major development on Main Reef Leader approached completion, work on the South Reef and Upper Leaders was accelerated. The sand-filling programme made good progress, and 638,000 tons were lowered into the mine during the year. In addition to affording support to the mine workings generally, this policy facilitates the reclamation of valuable remnants and pillars and assists the development and stoping of the Upper Leaders. The total payable ore developed during the year was 1,551,300 tons, of which 815,000 tons were on Main Reef Leader, averaging 9.8 dwt. over 48.9 in., 218,900 tons were on N.A. 1 and 2 Leaders averaging 6.1 dwt. over 44.5 in., 296,300 tons were on N.A. 7 Leader averaging 6.5 dwt. over 41.1 in., and 220,900 tons were on South Reef averaging 7 dwt. over 42 in. Expenditure on equipment amounted to only £3,041, and a further expenditure of some £13,000 has since been undertaken with the object of improving the efficiency of metallurgical operations and increasing the milling capacity by 4,000 to 5,000 tons per month. The larger scale of operating will in a measure offset the effect of the drop in yield which will result from the milling of an increased proportion of ore of lower grade from the Upper Leaders and South Reef.

Village Deep, Ltd.—This company showed improved working results for 1929, and increased its dividend distribution to 5%. On December 11 a provisional agreement was entered into with the Robinson Deep, Ltd., which has—since the close

of the year—been ratified by the shareholders of both Companies, under which the whole of the undermining rights, together with certain plant and equipment, were sold to the Robinson Deep, Ltd., as at the 1st February, 1930, for the sum of £337,500, payable £300,000 in cash against transfer and the balance twelve months thereafter. Since ratification of the agreement, preliminaries have been completed for the reduction of the capital of the Village Deep, Ltd., to £700,079 2s. in 1,000,113 shares of a nominal value of 14s. each, by cancellation of the 60,558 ex-enemy shares held by the Company and by returning to shareholders paid-up capital to the extent of 6s. per share. The distribution of this cash will, it is anticipated, be made early next month. Further sales of plant and equipment have been effected to the amount of £46,000. The reduction plant, which was not included in the sale, is now being operated by the Robinson Deep, Ltd., but will be returned to the Company at June 30, when clean-up operations will be undertaken by the Village Deep for its own benefit. The Company has other assets still to be realized, in the shape of freehold property, buildings and equipment, the best method of disposal of which is under consideration.

Goldenhuis Deep, Ltd., Nourse Mines, Ltd., and Rose Deep, Ltd., carried on normal operations during the year, the last-named Company proceeding with the opening up of the Southern Section of the mine, from which a small but steadily increasing supply of ore was drawn for the mill. The mining area of the Nourse Mines was increased by the acquisition of 50 claims adjoining its south-eastern boundary.

Ferreira Deep, Ltd., and the Wolhuter Gold Mines, Ltd., were placed in voluntary liquidation during the year 1929 on the exhaustion of their respective supplies of ore for current treatment. The Ferreira Deep, Ltd., made a cash distribution of 2s. 6d. per share, and its remaining assets were transferred to the Ferreira Estate Company, Ltd., a new Company with a capital of £192,765 in £1 shares, which were distributed among shareholders of Ferreira Deep, Ltd., on the basis of one share for every five shares held. This Company is proceeding to develop the freehold property in the form of an industrial township.

In addition to the Companies to which I have referred, the Rand Mines, Ltd., attends to the administration of the Transvaal Gold Mining Estates, Ltd., and Glynn's Lydenburg, Ltd. Among gold mining companies in which it is interested, but does not administer, are Daggafontein Mines, Ltd., and Modderfontein Deep Levels, Ltd.

Other Interests.—Your Company has recently acquired in conjunction with The Central Mining and Investment Corporation, Ltd., a substantial shareholding in the S.A. Coal Estates (Witbank) Ltd., whose Colliery adjoins the Southern Section of the Witbank Colliery. The South African cement enterprises in which your Company is interested are in an eminently sound position. The Northern Lime Company, Ltd., which supplies an essential product for the mines and for the sugar estates in Natal, is continuing to make steady progress. The turnover and profits of the Hume Pipe Company (S.A.), Ltd., were maintained.

Mr. J. L. Jourdan seconded the motion, which was carried unanimously.

MODDERFONTEIN DEEP LEVELS, LTD.

Directors : P. M. Anderson (*Chairman*), Sir William Dalrymple, Sir Robert N. Kotzé, C. L. Read, Sir Henry Strakosch, P. Strakosch. *Secretaries* : Union Corporation, Ltd. *Head Office* : Johannesburg. *London Office* : 95, Gresham Street, E.C. 2. *Formed* 1899. *Capital* : £500,000 in 5s. shares.

Business : Works a deep-level gold mine on the far east Rand.

The twenty-ninth ordinary general meeting of shareholders in the Modderfontein Deep Levels, Limited, was held at Johannesburg, on May 13, Mr. P. M. Anderson (*Chairman* of the company) presiding.

The *Chairman*, in the course of his remarks, said : A new milling record was set up for the fourth successive year by the crushing of a total of 531,500 tons of ore, this being 1,200 tons in excess of the previous year's record.

The yield per ton milled was 44s. 11d., and the working costs were 15s. 8-4d.

The profit on working was £777,402, or 29s. 3d. per ton milled, and exceeded the corresponding figure for the previous year by £3,796. Sundry revenue was £17,517, increasing the working profit to £794,918. Taxation absorbed £110,337 and charities £2,041, leaving a net profit of £682,540, or £3,846 more than in 1928, to be carried to the Appropriation Account.

After making the provision for the year towards the Company's liability to the Miners' Phthisis Compensation Fund, the balance of the net profit was insufficient by £7,460 to maintain dividends at the same rate as those declared for the previous four years, namely, 135 per cent. or 6s. 9d. per share. In view of the Company's sound financial position this shortfall was provided out of the balance carried forward in the Appropriation Account, thus reducing that balance to £143,273.

There was an expansion in the scale of develop-

ment work undertaken, the respective footages being 6,600 in 1929 and 4,782 in 1928. 5,319 feet of this work was on Hanging Wall Leaders, the footage accomplished in these horizons being nearly 60 per cent. greater than in 1928. Attention is now also being directed to the Leader 200 feet above the Main Reef.

The recalculation of the developed ore reserves at the end of the year disclosed that those on the Main Reef amounted to 2,550,000 tons of an average value of 8-8 dwt. over a width of 79 inches, the quantity being 450,000 tons less and the value a fifth of a pennyweight less than a year previously, the width remaining unchanged. In addition to these Main Reef ore reserves there were calculated to be developed 110,000 tons of an average value of 4-7 dwt. over a width of 60 inches in Hanging Wall Leader Blocks, bringing the total reserves to 2,660,000 tons, or 340,000 tons less than at the end of the preceding year.

For the first four months of the current year last year's milling rate has been maintained, a total of 174,300 tons having been dealt with as compared with 175,100 for the corresponding period of 1929. The revenue per ton milled has been about 1s. below last year's average, due in a great measure to the decrease in the value of the ore reserves. Working costs at 15s. 9d. have remained at approximately the same level, so that the working profit is about £10,000 less than was earned for the first four months of last year.

The Report and Accounts were adopted.

GENERAL MINING AND FINANCE CORPORATION, LTD.

Directors : Sir George Albu (*Chairman and Managing Director in South Africa*), L. Albu (*Managing Director in London*), J. Freudenthal, A. French. *Secretary* : H. W. Dalton. *Head Office* : Johannesburg. *London Secretary* : B. M. Ivson. *London Office* : Winchester House, Old Broad Street, E.C. 2. *Formed* 1895. *Capital issued* : £1,264,579.

Business : Finance of and investment in mining properties in the Transvaal and elsewhere.

The annual general meeting of the General Mining and Finance Corporation was held in Johannesburg on June 3, 1930, Sir George Albu (*Chairman* of the company) presiding.

The *Chairman*, in moving the adoption of the report and accounts for 1929, stated that stocks and shares would have shown a greater increase but for the considerable fall in the market price of certain holdings necessitating writing them down by £169,119. A very large proportion of this depreciation was due to Phoenix Oil and Transport Co., Ltd., shares which, owing to unfavourable conditions in world oil markets, had declined considerably during the year, but have since recovered substantially owing to improved prospects.

Although at one time the Corporation's interests were mainly centred in South Africa, these have gradually been extended to other parts of the world. It had never been their policy nor had it been thought desirable to give dull details of investments, but approximately two-thirds were represented by stocks and shares in South African concerns, and the remaining third elsewhere. There is, more especially in the latter, a large percentage

of sound, readily realizable securities such as railway and municipal stocks, which naturally greatly strengthens the more liquid resources. To summarize the position, apart from shares in mining and other companies which in themselves are an extremely valuable asset, the more realizable and what may be described as gilt-edged assets—in which category there was no hesitation in including the debt of the West Rand Consolidated—show a surplus of about three-quarters of a million pounds over current liabilities, which is indeed most satisfactory.

The *Directors* could not recommend the payment of a dividend, especially as it is very necessary in a business such as the Corporation's to maintain the strongest possible financial position, not only to meet ordinary obligations but for undertaking remunerative business when offering and financing associated companies when necessary. A good example of the latter is the large advances made to the West Rand Consolidated, with the result that the mine is now established on a firm basis with the practical certainty of a long and successful life, which otherwise would have been unattainable.

RHODESIAN ANGLO AMERICAN LTD.

Directors: Sir Ernest Oppenheimer (*Chairman*), Sir Edmund Davis (*Deputy Chairman*), L. A. Pollak and S. S. Taylor (*Managing Directors*), Sir H. Birchenough, Sir F. D. P. Chaplin, Carl R. Davis, S. B. Joel, J. G. Lawn, W. McDermott, F. Searls, Jnr., J. S. Wetzlar. *Managers and Secretaries:* Anglo American Corporation of South Africa, Ltd. *Head Office:* 4, London Wall Buildings, E.C. 2. *Offices in Africa:* Johannesburg and Broken Hill. *Formed 1928. Capital issued:* £3,390,812 10s. in 10s. shares.

Business: Finance of and investment in mining ventures in Northern Rhodesia.

ABRIDGED REPORT OF THE DIRECTORS.

For the period from the Incorporation of the Company (December 8, 1928) to March 31, 1930.

Submitted at the First Ordinary General Meeting held in London on Tuesday, June 3, 1930.

Incorporation.—This Company was incorporated with limited liability under the Companies Acts 1908 to 1917 on December 8, 1928. The Statutory Meeting of the Company to comply with the provisions of Section 65 of the Companies (Consolidation) Act, 1908, was held on February 20, 1929.

Capital.—The Company was formed with a capital of £2,500,000, divided into 5,000,000 shares of 10s. each. At an Extraordinary General Meeting of Shareholders held on October 29, 1929, the capital was increased to £3,500,000 by the creation of 2,000,000 new shares of 10s. each. The position as at March 31, 1930, was as follows:—Authorized Capital, 7,000,000 shares of 10s. each; issued Capital, 6,781,625 shares of 10s. each, fully paid. A resolution was proposed to increase the nominal capital of the Company, to £5,000,000 by the creation of 3,000,000 shares of the nominal value of 10s. each, so that in the event of further issues of shares being necessary in order to provide additional finance for the development of the assets in which your Company is interested, such issues could be dealt with promptly.

History.—The formation of the Company was planned by the Anglo American Corporation of South Africa, Ltd., which has, for some years past, been largely interested in the development of Northern Rhodesia, having been associated with Companies whose influence extends over the largest and most important mining areas in that territory. The experience gained indicated that additional finance on a very large scale would be required for the exploitation of the interests involved, and it was with the intention of providing a portion of the necessary finance that this Company was incorporated. The Anglo American Corporation of South Africa, Ltd., had associated with it in the formation of this Company, The British South Africa Company, The Johannesburg Consolidated Investment Company, Ltd., The Consolidated Mines Selection Company, Ltd., The Rand Selection Corporation, Ltd., The Newmont Mining Corporation, and others.

The initial capital of 5,000,000 shares of 10s. each was subscribed for in cash at premiums of 2s. 6d. and 3s. 6d. per share. With the cash which was received from this issue, this Company acquired from its chief shareholders important holdings in—Bwana M'Kubwa Copper Mining Company, Ltd., Rhodesian Congo Border Concession, Ltd., Loangwa Concessions (Northern Rhodesia), Ltd., Rhodesia Broken Hill Development Company, Ltd., and British South Africa Company. Subsequently the Company issued 1,781,625 shares at a premium of 30s. per share for cash, and with the proceeds enlarged its investments in the Northern Rhodesia

Copper Fields, principally in—Rhodesian Congo Border Concession, Ltd., Bwana M'Kubwa Copper Mining Company, Ltd., and British South Africa Company.

By arrangement with the Anglo American Corporation of South Africa, Ltd., and in succession to that Corporation, the Company has been appointed Consulting Engineers and Managers to a number of the important mining and prospecting companies in Northern Rhodesia. The Company has similarly been appointed Consulting Engineers in Northern Rhodesia to the British South Africa Company.

Finance.—The period covered by this Report has been a profitable one, and has resulted in a gross revenue from dividends, interest, share-dealings and other sources, of £746,425 1s. 8d. This gross profit has been dealt with as follows:—

Gross profit from dividends, interest, share-dealings and other sources	£746,425	1	8
Less—General			
Expenses	£32,074	16	9
Directors' Fees	1,637	4	7
		33,712	1
		£712,713	0
Less—Income Tax	144,204	8	7
Preliminary			
Expenses	27,141	13	7
Reserve Account	217,763	15	0
		389,109	17
Balance being Unappropriated			
Profit as at March 31, 1930	£323,603	3	2

The issue of the 6,781,625 shares by the Company resulted in a credit to Share Premium Account of £3,367,236 5s. The Directors have written off the expenses of the new issue, £85,000, leaving a net credit of £3,282,236 5s. This balance has been transferred to Reserve Account which has been built up to a grand total of £3,500,000 (equal to the total nominal capital of the Company) by the transfer of £217,763 15s. from Appropriation Account. The principal item on the asset side of the balance sheet is the shareholdings of the Company which at cost stood at March 31, 1930, at £5,662,371 3s. 8d. The market value of the shares at the date of the balance sheet shows a very large appreciation over the cost price. The loans amounting to £1,663,475 12s. 5d. are all at call, and are, therefore, available at short notice for the purposes of the Company.

Directorate.—Shareholders were asked to agree to increase the number of Directors to a maximum of fifteen.

N'CHANGA COPPER MINES, LTD.

Directors: F. L. Gibbs (*Chairman*), Sir E. M. Clarke, A. C. Howard, Carl R. Davis, Sir Edmund Davis, D. O. Malcolm, G. W. Gray, L. A. Pollak, C. E. Temperley, E. E. Marshall, J. Whitehouse.
Consulting Mining Engineers in Africa: Rhodesian Anglo American, Ltd. *Secretary:* H. C. Hankins.
Office: 20 Copthall Avenue, London, E.C.2. *Formed* 1926. *Capital issued:* £900,000.

Business: Is developing a copper property in Northern Rhodesia.

The third annual ordinary general meeting of the members of N'Changa Copper Mines, Ltd., was held on May 28, 1930, at Winchester House, E.C., Mr. Francis L. Gibbs (Chairman of the company) presiding.

The Secretary (Mr. H. C. Hankins) having read the notice convening the meeting and the auditor's report,

The Chairman, having dealt fully with the accounts, said: Attached to the directors' report are a memorandum by the Technical Committee and reports by the consulting engineers and the manager, with three plans, which fully explain the work which has been carried out by our company during the year under review. The results of the drill-holes which have been put down since the end of 1929 have already been communicated to the shareholders in the development report for the March quarter and in a circular dated May 15 last. The greater part of the work during 1929 has consisted of drilling operations, with a view to increasing the indicated tonnage of ore contained within our property. Only a limited amount of underground work has been carried on, and this has been on the River lode, but work here has been suspended for the time being pending the provision of adequate power.

As a result of the work which has been carried out during the year the tonnage of ore indicated within our property has been more than doubled, the greatest increase being seen in the New Discovery area, where at the end of 1929 the indicated tonnage of ore amounted to 54,170,000 tons, averaging 3.77% copper, of which 1.32% is in the form of sulphide, as against 21,551,000 tons of ore in the previous year, averaging 3.87% copper, of which 1.11% was in the form of sulphide. The total tonnage of ore indicated within our property at December 31, 1929, amounted in all to 64,641,000 tons, assaying 3.78% copper, as against 31,437,900 tons indicated at the end of December, 1928.

In view of the large tonnage of ore which has been indicated by boreholes in the neighbourhood of the New Discovery area, it has been decided to commence underground development here, and the first shaft, No. 10, is now being sunk, and had reached a depth of 165 ft. in the middle of this month. Further shafts are being sunk just over the boundary in the Rhodesian Congo Border territory.

Some shareholders have intimated to me that they find great difficulty in clearly understanding the relative positions of the River and Dambo lodes and the formations in which the N'Changa ore bodies occur. The plans accompanying the annual report show you the relation between the various formations which contain the ore. I find some difficulty in describing the situation in the N'Changa area in non-technical language, but I will try to make it as plain as I can. To understand the situation, you must picture a trough, or syncline as it is known in technical language, the bottom

of which runs in a general easterly and westerly direction. This trough is made up of parallel bands of shales, quartzites, etc. The upper ore-body, or Dambo lode, is in what is known as felspathic quartzite. This ore-body has been shown to contain a large tonnage of ore on the south side of the syncline, but has not yet been explored in depth on the north side. It appears from the drilling that the eastern limit of payability is round about drill-holes C. 1 and D. 15. The ore extends in a westerly direction to the western boundary of the N'Changa area, and for some distance into the Congo Border area at this end. Underlying the upper or felspathic formation is another formation practically parallel known as the Lower Banded Shale.

The lower ore-body is contained in this Lower Banded Shale formation, and in the two formations immediately below it. It is this ore-body which has been explored on the north side of the syncline under the name of the River lode. It is this same formation which contains the large tonnage of high-grade ore being developed to the west of the N'Changa area in the Congo Border ground. The intervening distance—that is, between the River lode outcrop and the Congo Border area on the west—has not yet been fully explored. That the formation exists in this area has been proved, and it is cut by four bore-holes, D. 11, B. 19, B. 20 and B. 39, all of which, excepting D. 11, showed appreciable values. To the west and north of these bore-holes, it has, however, not yet been intercepted, and it is in this area that there exists the possibility of discovering ore similar to that encountered in the Congo Border area to the west.

With regard to the metallurgical treatment of our ores, you will recollect that at our last general meeting you were informed that the Board was considering the installation of a pilot plant to deal with 100 tons of mixed oxide-sulphide ore per day by the Minerals Separation segregation process. After a careful examination had been made of the position by our Technical Committee they came to the conclusion that it would be wiser, before installing the pilot plant, if shafts were sunk so as to ensure that truly representative ore would be treated in the plant, that adequate power was provided and that the transport facilities were improved. As you have been informed, one of the shafts is in progress of being sunk, two 625 kw. turbo-generators have been purchased and are now being installed, and the extension of the railway from N'Kana to N'Changa is in hand.

I am glad to be able to inform you that Mr. H. A. Tobelmann, who has had considerable experience in the treatment of complex ores in America, has been engaged by our company to make a thorough investigation of the situation and submit his recommendations to the Board. Mr. Tobelmann sailed from England in the middle of April, and is expected to arrive at N'Changa at about the end of the present month. We are also fortunate in being able to have the advice of

Mr. McNab, a metallurgist of great experience in copper metallurgy in America. Mr. McNab has recently visited Africa on behalf of our consulting engineers, the Rhodesian Anglo American, Ltd., and while there has had an opportunity of inspecting our property and studying the conditions on the ground.

Regarding transport facilities, I am glad to be able to say that the branch line of the Rhodesia Railways from N'Dola to N'Kana was opened for traffic on the 25th of this month, and an agreement has been entered into between this company, the Rhodesian Congo Border Concession, Ltd., and the Rhodesia Railways for the extension of this branch line from N'Kana to N'Changa. The construction of the extension is already in hand and it is hoped that it will be completed by May, 1931. It is unnecessary for me to emphasize the importance of this extension as it will bring our property into direct railway communication with the main line of the Rhodesia Railways and thus with Beira and Cape Town. A new all-season road has been constructed from N'Changa to Tshinsenda in the Belgian Congo.

The mining companies of Northern Rhodesia have been considering the provision of cheap and adequate power, and in order to investigate this question thoroughly a company—the Northern Rhodesia Power Corporation, Ltd.—has been formed, and our company has acquired an interest in this corporation.

I mentioned in my speech last year that steps were being taken by the companies operating in Northern Rhodesia to deal with the native labour situation. As you have observed from the reports of the consulting engineers and the manager, no

serious shortage of labour was experienced during the year. The continually increasing demand for labour, however, which is taking place throughout Northern Rhodesia, makes it essential that steps should be taken to ensure that each company receives its proper quota of labour, and also that wages and working conditions are standardized. A Native Labour Association has therefore been formed on co-operative lines.

Mr. G. C. R. Stewart, formerly chief mining engineer of the Rio Tinto Company, has been appointed the general manager of our company in Rhodesia, and he is expected to arrive at N'Changa almost immediately. Mr. Stewart has acquired a reputation for efficient and energetic management and our company is to be congratulated upon obtaining his services. I have to announce that Mr. A. Chester Beatty and Mr. W. Selkirk, both of whom has been associated with this company since its formation in 1926, have with great regret retired from this Board owing to pressure of business. I should like to add that this regret is shared by myself and all my colleagues. Mr. J. Whitehouse, who is associated with Mr. Chester Beatty's organization, has been appointed a director of the company, and he is with us to-day.

In conclusion, I should like to express our thanks to our consulting engineers, the Rhodesian Anglo American, Ltd.; our manager, Mr. W. Burns, and to all the members of our staff for the way in which they have carried out their duties during the past year.

The directors' report and accounts for the year ended December 31, 1929, having been adopted, the retiring directors re-elected and the auditors reappointed, the meeting terminated.

BOULDER PERSEVERANCE, LTD.

Directors: C. F. Bell (*Chairman*), H. F. Jackson, K. B. Edwards. *General Manager:* Ernest Williams. *Secretary:* P. C. Escott. *Office:* 607-9, Salisbury House, London Wall, E.C.2. *Formed* 1923. *Capital issued:* £124,793 6s. in ls. shares.

Business: Operates the Perseverance gold mine at Kalgoorlie, Western Australia.

The sixth ordinary general meeting of Boulder Perseverance, Ltd., was held on May 28 at Winchester House, E.C., Mr. C. F. Bell (*Chairman* of the company) presiding.

The *Chairman*, in moving the adoption of the report and accounts for the fifteen months ended December 31 last, referred to the fact that the mine profit was lower than in the previous accounting period on account of the drop in values for a part of last year, and also the delay in renewing the tribute in the adjoining property. Additional heavy expenditure on development work had transferred the slender mine profit into a loss, to which had to be added the London expenses. Dr. Stillwell's report had mentioned that the Perseverance was the most extensively prospected mine on the field down to the 1,100 ft. level, but that considerable scope remained for the search for enrichments. Below the 1,100 ft. level the exploration was less extensive on account of the failure to locate payable shoots. The development work of the past year had, however, developed promising lodes below the 1,100 ft. level—namely the East Boundary lode on the 1,600 ft. level, encountered both above on the 1,450 ft. level and below on the 1,750 ft. level; also a payable quantity of ore on the Lake View boundary, between the 1,450 ft. and 1,600 ft. levels.

Development work was not sufficient, and, as mentioned at previous meetings, the necessity for reduction of working costs had caused intensive research work to be initiated by Dr. Edwards, which had given such promising results that the Westralian Government, with all the facts before them, had promised £10,000 towards the cost of a new plant. This, after three months' careful consideration, would cost about £66,000, and, the company's finances being insufficient, the Board had accepted an offer from outside sources for the provision of the necessary money, and it was expected that a separate treatment company would shortly be registered, in which this company would have a share interest and be entitled to a prior right for its output to be treated. Shareholders would have an opportunity of subscribing towards the issue of capital, and, seeing it meant a saving of some £15,000 a year, he (*the Chairman*) strongly supported the advisability of so doing.

After the *Chairman* had referred to the position of the Enterprise Syndicate, in which this company was interested, and the financial position in Australia, more particularly as regards the agitation for the gold bonus and the exchange premium, the adoption of the report and accounts was moved and seconded.

The report was unanimously adopted.

ASSOCIATED TIN MINES OF NIGERIA, LTD.

Directors : Hon. Lionel Holland (*Chairman*), Major E. Seaborn Marks (*Managing Director*), Sir William D. Henry, Louis Hardy, F. J. Peek, J. G. Foley. *Consulting Engineers and General Managers* : Foley, Boyes, Butler, and Peek. *Secretaries and Office* : The Anglo-Oriental and General Investment Trust, Ltd., 31 and 33, Bishopsgate, London, E.C.2. *Formed 1926. Capital* : £1,000,000 in 5s. shares.

Business : Operates alluvial tin properties on the Bauchi Plateau, Northern Nigeria.

The third ordinary general meeting of the shareholders of the Associated Tin Mines of Nigeria, Ltd., was held on May 30 at the Fur Trade Sale Room, Garlick Hill, E.C., the Hon. Lionel Holland (*Chairman of the company*) presiding.

The *Chairman*, in moving the adoption of the report and accounts for the year 1929, said : Ladies and gentlemen,—The directors' report and the accounts that I have now the privilege to submit for your acceptance make, I think, a not unfavourable showing when we take into consideration the adverse conditions that have prevailed during the period that the accounts cover. The price of standard tin never rose above £229 a ton, and the average for the twelve months was no more than £204. We received then an average price during the financial year for our 70% tin concentrates of £142 9s. 11d. a ton—an appreciable reduction even compared with the low record, £158 2s. 1d., of the preceding eighteen months that were included in our last accounts. Our financial year ended on December 31 last ; and the results of the year's operations have served to establish the all-important fact that, even with the commodity at a price abnormally depressed, this undertaking, as now organized, can work at a profit. To this knowledge is added the certain assurance that, with any appreciable recovery in price, this modest rate of profit will be substantially and progressively enlarged until shareholders are rewarded with an adequate return on the capital that they have embarked in the business. That, after all, is our main concern, and I shall venture to trouble you with a few figures to illustrate the point.

When we met on the occasion of the annual meeting last June ; I stated in my speech that the working costs for the accounting period of 18 months with which we were then concerned had averaged £94 5s. a ton. The advantage and economies of the consolidated programme of operations, rendered possible by an amalgamation of mining properties, had only started to make headway, although before the close of the period working costs had been reduced to something under £90 a ton. I hope that no shareholder here will have failed to read the illuminating report of our general managers in Nigeria—the engineering firm of Messrs. Foley, Boyes, Butler, and Peek—on the year's field operations, which is printed in full at the end of the directors' report. We shall note there that the all-in working costs have realized a very substantial reduction to an average for the 12 months of £82 8s. 3d. a ton, free on rail at Bukuru. And this reduction has been and continues to be progressive. The assurance given by the managers in their report that a further reduction in working costs would be effected during the current year has already been confirmed. During the more recent months the working costs have fallen to £74 and less a ton of tin concentrate—over £20 a ton below the average for 1928—and it is our confident

understanding that they will be further appreciably reduced.

For the purpose of calculation, however, I will take the higher figure of £74 as the costs in Nigeria up to the delivery of the concentrates at the rail-head. To this we must add the subsequent charges before the concentrates are realized, including railway and ocean freight, royalty, insurance, handling and returning charges, and also the secretarial and general expenses. These together amount to approximately £22 13s. 3d. a ton. Of this total the railway freight exacts no less than £8 3s. 3d. a ton, which appears to me, especially under existing conditions, an altogether unjustifiable impost for a journey of some 500 miles from the Plateau to Port Harcourt, or about 4d. a ton per mile, whereas the cost to the railway department cannot exceed 2d. a mile.

We come, then, to an all-in figure of some £96 13s. 3d. to set against the value we receive for our product, which is £105 a ton on our grade of concentrates with the price of standard tin at £150 a ton, and even taking standard tin at the unreasonable price of £140 it would still be £98 per ton. As the present price of the metal is very substantially below the average world cost of production, it is obvious that such a level cannot endure, while each advance in price represents practically an equivalent net gain, since, except for an increase in royalty and a small addition to insurance and returning charges, these all-in cost figures do not vary with the varying price of the metal. Apart from their immediate application, I am glad to give these figures, since they will enable any shareholder who so wishes to follow and judge more readily the fortunes of the company, as the other data needed to complete the reckoning are always available. The quotation for standard tin is common knowledge and the Associated month's production is published regularly—usually the first week of the ensuing month.

For the twelve months now under review our company's production was 3,062 tons of concentrates—a considerable increase upon the showing for the previous year—just about equal to the production for the preceding 18 months. It might easily have been augmented, but no policy could be more wasteful and ill-timed than to press production and diminish the reserves of ore latent in the property while the price for tin admits of no adequate return. Since the first month of the current year—since last January—we have reduced the rate of production from an approximate monthly return of 250 tons to a maximum of 200 tons a month. We have cordially accepted, and shall loyally observe, the policy of the Tin Producers' Association, and unanimously endorsed by its members at their meeting in this hall about a month ago, a policy that in effect regulates the output of producing companies that are members of the association to 80% of their 1929 output.

Difficulties and price depression inevitably succeed to a period of inflated values. But in the case of tin, had the position been taken in hand betimes, quite a trivial measure of regulation would have maintained the commodity at a reasonable and remunerative price. For the really satisfactory feature in the situation has been the steady annual growth in the world consumption of tin, from 149,000 tons in 1926 to 179,900 tons last year. Yet for the past three years the price of the commodity has, nevertheless, steadily declined.

General trade conditions make it unsafe to budget on any further growth in the world consumption of tin during the current year, while, unless production be retarded, it is estimated that it would reach an output of 191,000 tons this year. With the rate of production unchecked, the surplus stock ruinously augmented, it would be impossible to predict to what new low level of price the commodity might not fall. Where a cut of 5% in the world output two years ago would have sufficed, a reduction of at least 20% is now imperative to reduce stocks by degrees to a normal level, so that the price of tin may be gradually advanced to a remunerative figure. And I should certainly regard no figure under a minimum of £220 a ton for standard tin as a price equitable to producing companies when we consider their obligation not only to provide for a fair annual return on the capital invested in their enterprise, but funds for the amortization of that capital and for the depreciation of plant.

I have thought it incumbent on me to offer on this occasion an explanation—scarcely a defence, for no defence is needed—of the action of your Board in supporting the Tin Producers' Association and assenting to an appreciable curtailment of output—an output that could easily have been increased. But, if for no other reason, a sense of honour, of loyalty, alone would have dictated co-operation. It is not morally permissible for one or two companies to stand out, and steal an advantage from the sacrifice of others. Nor would the immediate gain—the wage of their treachery—prove other than a loss in the long run, for nothing can be more hurtful than the prodigal exploitation of a vanishing asset at uneconomic prices.

We produced and sold during the past financial year 3,062 tons of concentrates, and received for them, as you will have noted in the profit and loss account, £436,319. Against this revenue we have to set the working expenses on the field, transport, royalties, smelting charges and other expenditure in Africa and London, which amount altogether to about £354,935. To the mining profit remains to be added a small balance of profit from other transactions amounting to £7,136, resulting from our participation in the formation of the Nigerian Electricity Supply Corporation. A public issue of 400,000 Preferred Ordinary shares of £1 each, made soon after the close of our last financial year, supplied the Corporation with the funds to take over the property at the Kurra Falls and the work that was in progress there, and to complete the dam, and build and equip the power house. I referred to the scheme, and to the excellent prospects of the Power Corporation, in some detail at our last annual meeting, and I need only add now to what I then stated that the work is well up to time, and the provision of power to some areas on the field should com-

mence during this summer in accordance with the programme that was originally formulated. Besides just upon 5,000 of the Corporation's Preference shares, our company owns approximately half of the Ordinary share capital of the Power undertaking, which, apart from their importance to us for obvious reasons, in due course should prove a valuable and profitable holding.

You may have noticed in the balance-sheet that among the investments—shareholdings in companies working on the plateau—that we hold, valued together at £258,160 odd, are included some £93,000 of shares that have no Stock Exchange quotation. This figure, except for a couple of minor items that together do not total more than £100, represents our holding of Ordinary shares in the Nigerian Electricity Supply Corporation. The balance of quoted shares shows practically no variation from the holdings—all of producing companies on the plateau—that I enumerated last year. These investments are taken at cost, £164,847, and it is assuredly not unsatisfactory that, in spite of a steady decline in the market values of Tin securities during the past 12 months and more, they have suffered a depreciation of under £9,700, taking, instead of cost, the basis of market prices at the end of last year, which are approximately the same as the market quotations now. We are applying £40,000 out of profits as an allocation to the reserve fund to cover not only this small depreciation in the market value of these investments, but also any possible further depreciation or loss should the depression in tin values continue. Besides the proceeds from sales of tin and profits on realizations and some £500 from transfer fees, our total income revenue for the financial year is brought up to £453,463 by the addition of £9,000 or so credited for interest on loans. These loans are to the companies in which we are interested as predominant shareholders, to enable them to continue their necessary development and other operations during the present depressed state of the metal market. I think we may be fairly sure that our next accounts will show some reduction in the total under this entry. Indeed, it has already been slightly reduced since the accounts were closed. And we have the safeguard that these companies have no other obligations, that they have no debentures or other liabilities of any description outstanding.

We arrive, then, at a balance of profit for the 12 months of £98,527. To this there is £108,617, the balance of profit carried forward from last year, to be added, and income-tax, £21,915, to be deducted, leaving a disposable profit of £185,228 to be dealt with. Of this amount £36,857 is needed for depreciation of plant and machinery, and we propose, as I have said, to allocate £40,000 to reserve account. There is also £10,000 appropriated as a special reserve for subsidiary companies, which more than covers the small deficiency on their last accounts.

On the last occasion that we met no distribution in the way of a final dividend was recommended. The depressed price of the commodity and the uncertainty of the outlook enjoined exceptional caution. The considerations that prevailed against declaring a dividend a year ago have, unfortunately, not weakened in force; the outlook seems little

altered from what it appeared then. In one way it is indeed definitely less favourable, for the price of tin is very materially lower. From another point of view, to my mind, it is eminently more favourable, since producers have arrived at an understanding to check wasteful production. The financial position of this company is a reasonably strong one. The balance-sheet shows that, apart from its mining investments and loans, its fluid assets—cash in hand and on deposit, debtors and stock of tin—exceed its current liabilities by nearly £158,000, and, speaking generally, where a company has earned a profit on this year's working sufficient to pay a dividend to its shareholders, after providing adequately for depreciation and a sum to carry forward, it is only to my mind under very exceptional circumstances that a dividend should be withheld.

Until quite recently, then, I had hoped that we should have been able to-day to have submitted for your approval a resolution to pay a dividend on the past year's working. But the further heavy fall in the price of the metal that has lately occurred, and the unsettled outlook both in the metal market and general trade position, have compelled us to revise our programme. If the price of the commodity should fall further, or if it does not recover, with no surplus revenue accruing to replenish our resources or to meet additional expenditure, it becomes a vital necessity to the stability of our undertaking that its cash resources should be conserved. There is expenditure that must be met, and other expenditure—such as the electrification of the plant which is approaching completion—that it would be most injurious to retard; and if we are to experience another nine or twelve months of the prevailing low prices of tin, every pound of our cash resources may be needed to preserve the business in safety. I trust that any such continued period of depression is highly improbable, but we must be armed against it. On the other hand, if the price of tin revives, the greater part of our profit—over £90,000—is not allocated, but is available in the carry-forward, and we shall gladly embrace the opportunity of paying an interim dividend when it can be distributed without endangering the future prospects of the business. In following this policy your Board have ascertained that it has the approval of the largest individual shareholders in this company, who agree that its interests will be best served by postponing the payment of a dividend until the outlook becomes clearer. And in this view I think, on reflection, most of us here will concur.

In regard to the year's field operations, I take it, gentlemen, that you have read or will read the report of our managers in Nigeria upon them. The continuing reduction in mining costs I have referred to already, and since January 1 of the present year the company is getting some relief from the temporary suspension of labour obligations and a reduction in rent to 1s. an acre on mining leases. I am afraid, however, that the Government of Nigeria have still no adequate appreciation of the gravity of the position. In spite of the urgent representation of the Council of the Nigerian Chamber of Mines, no relief has yet been granted from the onerous expenditure required to keep alive prospecting licences. Obligations that the industry can bear

without injury when the price of tin exceeds £250 a ton have little justification when levied upon an industry fighting for its very existence. Nor, again, is it equitable that revenue raised under these conditions from Northern Nigeria should be lavished on costly schemes that can benefit only the population of Lagos and the south, while the provision of transport facilities on the plateau is held up for lack of funds. I earnestly hope that the Government will not continue unresponsive to the grave and urgent need of our industry.

Our managers' report contains satisfactory evidence of the increased efficiency and economy which have been alone rendered possible by the centralization and grouping of large interests on the field. Central offices at Rayfield, a central machine shop and central stores, with a railway siding to cheapen the cost of handling at Bukuru, a central mill to treat the whole output from our own and other of the grouped Anglo-Oriental areas, a central transport and overhauling station are completed and have already contributed substantial savings, while the company is fully equipped with plant that can now be employed in any section where it can be used to the best advantage over the whole of our extensive areas. Incidentally I might also mention that for the benefit of the staff of all the associated companies we have established a central canteen at Jos.

In achieving these results with a minimum of delay and for the successful conduct of its field operations, this company is, above all, indebted to the unrivalled experience of the conditions and requirements of Nigerian mining of the partners of the firm of Messrs. Foley Boyes Butler and Peek—our managers in Nigeria—to their keen solicitude and loyalty for the interests of the company, to their energy and ability. The most promising mining areas and the most up-to-date plant are of little value without the individuals and management to work them to the best advantage. In each respect our company is strong. It owns areas of wide extent—some 35,000 acres under mining leases and some 130 square miles under exclusive prospecting licences—that prospecting has proved to be of increasing promise, grouped in the Northern and Southern divisions of the plateau. They are fully equipped with plant, and before long some of the Southern sections will be supplied with electric power. The general control of the organization and mining programme in Nigeria is in the capable hands, as I have said, of Messrs. Foley Boyes Butler and Peek, and they pay in their report a well-merited tribute to the admirable work of the area managers, Mr. Nigel Cooke and Mr. W. R. Clarke, who are in command of mining operations on our Northern and Southern areas respectively, and to their staff; while here in London the Board is assisted by the ability and skilled advice and judgment of the managing director, Major Seaborn Marks, and by the experience and influential connections of our Secretaries, the Anglo-Oriental and General Investment Trust. One sad loss your Board and company have suffered during the year through the death of Mr. Temple Harris, whose association with mining on the plateau, as Chairman of the Northern Nigeria Bauchi Company and as an

active member of the Nigerian Chamber of Mines, has been long and distinguished.

Gentlemen, I am very sensible of the patience with which you have listened to me, and it would be a poor acknowledgment of your courtesy were I to detain you still further by recapitulating information about the progress and conduct of operations on the field that is readily accessible to you in our managers' report. The outstanding feature that testifies to the importance and great value of our undertaking is the assurance that our properties contain large bodies of payable ore that will maintain the present rate of output for many years to come. Last year we took out of the property over 3,000 tons of ore, but prospecting work during the same period located over 6,000 additional tons; we increased our reserves by 3,000 tons, bringing the reserves of proved ore up to 22,128 tons. Especially within our southern areas have rich deposits been located upon some of the mining leases and prospecting licences where prospecting has been in progress.

Although we are restricting output, we shall maintain the programme of prospecting work. I am glad to be able to tell you to-day that already, since January 1, no less than 9,000 additional tons of payable ore have been located, bringing up our actual reserves to the handsome figure of over 31,000 tons, and our engineers are confident that the presence of additional important deposits will be disclosed as the result of scout drilling during the current year, offering further proof—if proof be needed—of the essential stability of this company's position, and of its assured prosperity when happier conditions come to prevail in the tin industry.

I will now formally move the resolution: "That the report and accounts for the 12 months ended December 31, 1930, be and the same are hereby received and adopted," and I will ask Mr. Foley to second the resolution.

Mr. Foley has not been long here and in a few weeks he will be returning to the plateau. It is fortunate for us that his visit has coincided with the date of our meeting. I think I shall be expressing the wish of the shareholders if I ask Mr. Foley not to keep to a mere formal seconding of this resolution. We have the report of his firm, of course, before us, but after all it is a different thing to hear from Mr. Foley himself his personal views as to the development work in progress and particularly the development that has occurred since the close of the financial year. As you know, no one can speak with more authority, and his judgment and candour is held in the highest regard.

Mr. J. G. Foley said: I personally represented the interests of organizing and centralization on the lines on which we are working to-day; that organization and centralization to include the electrification of the Nigerian tinfields. At the end of 1927 my partners and I strongly represented to my late chairman the position that would arise in the event of the price of tin dropping unless some steps were taken to reduce working costs. The replies from London were that they fully appreciated the situation, but they had not the financial resources to bring it about; they would, however, do their best in the interests of

all concerned. A few months later I heard of the steps they had taken. At that time I was not quite sure of the position from the point of view taken on this side, and I was generally opposed to the scheme they had adopted. However, I was sent to this side, and our scheme was adopted.

In addition to that, we have been able to develop the property on a much more extensive scale than would have been possible had the old conditions continued to prevail. I cannot illustrate my point better than by referring to the state of your ore reserves to-day. At the date of the amalgamation the ore reserves were in the neighbourhood of 20,000 tons, and we were then forcing production. That was the most alarming feature of our operations at that time. To-day, due to instructions received from this side, we have been able to adopt a very extensive scheme of prospecting, which has led to our locating vast deposits, particularly in the southern areas, and most fortunately situated in view of the proximity of these areas to the electric power station. The main feature of that is that, instead of taking the eyes out of your mine, you are able to work on methodical lines, and the only trouble is to keep your output down to comply with the restriction scheme. It would be much easier to increase the returns by 50 tons than to reduce them by that amount, for the organization and centralization that has been built up gives an average annual return of 3,000 tons.

The prospecting programme needs a little further explanation. At the time it was adopted, by arrangement with the Board in London, it was decided we should prospect sufficiently to replace the amount of tin which we extracted. We went on those lines having regard to the 3,000 tons production being replaced by 3,000 tons of additional reserves. But when this depression came we had a large number of men on our staff in Nigeria who were under agreement to us and in order to restrict output we found we should have to dispense with them. We therefore decided, with the concurrence of the Board in London, not to send these men home, but to keep them on the property to speed up prospecting. That is the reason why, in the first three months of this year you have proved 9,000 tons of tin against anticipated additional reserves of 3,000 tons. I think the expenditure will be amply justified in the very near future, for I do not think you need hesitate to spend money on capital account for any longer than another eighteen months. By the end of that time I shall be surprised if there is not nearer 50,000 tons than 30,000 tons, and I make that assertion with a reputation extending over eighteen years. You have in the properties of this company 75% of the whole plateau—that is, from the point of view of payable ground. This extensive prospecting scheme is leading us rapidly to discard valueless areas. I do think that we are to-day, thanks to this centralization and combination of interests, in a very happy position, and I shall be very greatly surprised, if the metal reaches a reasonable price, if and when we meet you next you do not realize how good it was that this state of affairs was brought about.

After the Chairman had replied to questions, the resolution was carried.

KADUNA SYNDICATE, LTD.

Directors : Commander C. J. R. Livingstone-Learmonth (*Chairman*), J. W. Anderson, Sir Godfrey B. H. Fell, Charles Leach, L. B. Robinson. *Secretary* : F. Lee. *Office* : 16, St. Helen's Place, London, E.C. 3. *Formed* 1910. *Capital issued* : £40,000 in 5s. shares.

Business : Operates alluvial tin properties in Northern Nigeria.

The nineteenth annual general meeting of the shareholders of the Kaduna Syndicate, Ltd., was held on June 11 at 16, St. Helen's Place, London, E.C., Commander Livingstone-Learmonth (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended October 31, 1929, said : Gentlemen, since I last had the pleasure of addressing you, the price of tin has fallen from about £200 per ton to £137 yesterday. However, for the period under review, our product was realized on the basis of £203 per ton for the metal, or £145 14s. 7d. per ton gross for the concentrate, as against £160 6s. 5d. gross per ton of concentrate, for the preceding financial year. The net profit per ton of concentrate averaged £38 4s. 11d. against £33 18s. 9d. last year, and I think the management and staff merit your congratulations for the way costs have been reduced.

The output was 464 tons, or an increase of 82 tons as compared with the output of the previous year, and this, together with a substantial reduction in production costs, has enabled us to show a net profit of £17,744. Last year we carried forward £2,666, so that we have for disposal £20,410. An interim dividend of 10% has been paid, and it is now proposed to pay a final dividend of 10%, making 20% for the year, absorbing £8,000, and leaving £3,641 to be carried forward. Our financial

position remains sound, the liquid assets, including stores, amounting to nearly £66,000.

I referred last year to our having acquired a share interest in a company—Maroc, Ltd.—carrying on prospecting in Sierra Leone. Reports continue promising, and you now hold approximately 12½% of its issued capital. A small amount of gold has been recovered, and prospects there are encouraging. East Africa Explorers, Ltd., too, has acquired tin-bearing ground in Nigeria, and is recovering a small quantity of tin ore each month, but, with the metal at its present price, we understand that it is proposed to develop the areas with a view to the future rather than to increase output. We believe that your holding of approximately 25% of the issued capital will turn out to be a profitable investment.

The tin industry is at present going through a crisis that occurs periodically, and is the result of over-production. The Tin Producers' Association has been organized, and we are members of the association, and entirely in sympathy with its objects.

Several shareholders have inquired whether there is any truth in rumours they have heard that the control of this syndicate was to pass into other hands, and I take the opportunity of assuring you that, owing to the loyal support you have given to your directors you still retain your independence.

The report and accounts were unanimously adopted.

KADUNA PROSPECTORS, LTD.

Directors : Commander C. J. R. Livingstone-Learmonth (*Chairman*), J. W. Anderson, Brig.-Gen. Lord E. Gordon-Lennox, Charles Leach, D. J. Mooney. *Secretary* : F. Lee. *Office* : 16, St. Helen's Place, London, E.C. 3. *Formed* 1913. *Capital issued* : £30,000 in 5s. shares.

Business : Operates alluvial tin properties in Northern Nigeria.

The fifteenth annual general meeting of the shareholders of Kaduna Prospectors, Ltd., was held on June 11 at 16, St. Helen's Place, London, E.C., Commander Livingstone-Learmonth (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended October 31, 1929, said : Gentlemen, notwithstanding the fact that during the year under review the output was practically 22 tons less, and the average price of the metal lower by approximately £21 than for the preceding year, the net profits are down by some £185 only, and I think that great credit is due to the management for bringing about the substantial reduction in production costs. The accounts show a net profit of £7,768, which, added to the carry-forward of last year of £2,987, gave an available balance of £10,755. In view of the low price prevailing for the metal, your directors considered it advisable to transfer £2,500 to reserve for taxation and contingencies, and they have written off £2,614 6s. of the expenditure on properties, leaving the book value at £20,000. An interim dividend of 5% has already been paid, and it is proposed to pay a final dividend of 5% making 10% for the year, which absorbs £3,000, leaving £2,641 to be carried forward.

During the year under review, our output of concentrate was realized at an average price of £150 14s. 4d. per ton of concentrate, equivalent

to £202 per ton of metal. The price yesterday was £137, and unless it improves during the next six months we can hardly hope to see a profit for the current year. At the same time, there has been a large reduction in the cost of production.

We have already had properties offered to us, and, in view of the possibility that an advantageous opportunity for acquiring valuable ground may eventuate, your directors consider it advisable that the company should be in a position to offer shares in full or part payment. They are, therefore, asking you to authorize the increase of capital from £40,000 to £60,000. It is not proposed to issue any of this at the present moment.

You will see from the report that your company has an interest in East Africa Explorers, Ltd., and in Maroc, Ltd. East Africa Explorers, Ltd., in which you hold approximately a 25% interest, has acquired some very promising ground in Nigeria. Maroc, Ltd., is operating in Sierra Leone, and prospecting to date has been carried out with encouraging results. In this company you hold 12½% of the issued capital.

Considering the bad times we are passing through, it appears to me that this company can look to the future with equanimity. We still retain our independence.

The report and accounts were unanimously adopted, and the increase in the capital approved.

SIAMESE TIN SYNDICATE, LTD.

Directors : William H. P. Stevens (*Chairman*), Sir Cyril K. Butler, Sir James Heath, T. Gilbert Scott, Henry G. Scott (*Managing Director in the East*). *Secretary* : C. A. Underwood. *Office* : Capel House, New Broad Street, London, E.C. 2. *Formed* 1906. *Capital issued* : £150,000 in 5s. shares.

Business : Works an alluvial tin-area at Ngow, Renong district, Siam.

The twenty-third ordinary general meeting of the Siamese Tin Syndicate, Ltd., was held on June 11 at Winchester House, London, E.C., Mr. William H. P. Stevens (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for 1929, said that the past year's mining operations resulted in a total revenue from ore sales amounting to £235,729, an increase of £55,327 compared with the previous year, the total output, 1,661.44 tons, having shown an increase of some 511 tons. The net average price per ton received, before deduction of Government duty, was £141 17s. 8d., against £156 17s. in 1928. The net profit amounted to £51,812, compared with £27,013 in the previous year. Three interim dividends of 10% each were paid during 1929, and £5,367 was being carried forward.

They had been offered an option covering some 9,000,000 cubic yards of tin-bearing ground in close proximity to that part of their Ngow Estate, which was being worked by their No. 1 dredge. If, on check-boring the area in question, satisfactory results were obtained and the option was exercised, this would mean a very substantial extension to the life of the Ngow Estate, as there would probably be an additional ten years' work for No. 1 dredge.

The production from the five dredges of the company of a total of 1,661 tons in 1929 was a very good

indication of the value of the company's properties ; and if the average price of tin had been anywhere near that obtained over the previous five years the profit on the company's small capital would have been very large indeed. The price of tin at the moment was, from the point of view of the producer, anything but satisfactory, and the steps which had up to the present been taken to restrict output did not appear to have had the desired effect.

The directors had thought it undesirable, in the interests of the shareholders, to accept the invitation for the company to become a member of the Tin Producers' Association, considering it preferable in all the circumstances to maintain an entirely independent position. At the same time, they had voluntarily adopted the policy of restriction by ordering a weekly stoppage of twenty-four hours on all their dredges, and, in view of the further fall in the price since this policy was adopted, it might become necessary to face a more drastic form of restriction in the near future.

Although the clouds looked dark at the present time, in the long run the silver lining was pretty sure to be revealed, and, even in the conditions which had so far prevailed this year, the profit earned was sufficient to justify the directors in determining, as they had done that morning, to declare an interim dividend of 10% in respect of the current year's working.

The report was unanimously adopted.

BANGRIN TIN DREDGING CO., LTD.

Directors : William H. P. Stevens (*Chairman*), Sir Cyril K. Butler, T. Gilbert Scott, Henry G. Scott. *Secretary* : C. A. Underwood. *Office* : Capel House, New Broad Street, London, E.C. 2. *Formed* 1920. *Capital* : £300,000 in £1 shares.

Business : Operates an alluvial tin property in the Renong district, Siam.

The tenth ordinary general meeting of the Bangrin Tin Dredging Co., Ltd., was held on June 11 at Winchester House, London, E.C., Mr. William H. P. Stevens (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for 1929, said that the total revenue from mining operations during the past year amounted to £98,154, compared with £77,596 in the previous year. The output of 698.93 tons of ore—compared with 498.36 tons in 1928—was obtained from the operation of their three dredges, but No. 3 dredge on the Bangrin Extended property only commenced operations during July. The average price obtained for ore sold in the East had been £140 8s. 9d. per ton, compared with £155 14s. 1d. in the previous year. The mining properties stood in the accounts at £322,010; additional capital expenditure of £32,266 having been incurred during the year, of which £3,510 related to the conversion of No. 1 dredge to operation by electrical power, and £28,755 to the further equipment of the Bangrin Extended property. The balance of profit, including the amount brought forward, was £21,920, and the directors recommended that £5,000 be added to the reserve, increasing it to £10,000, and that £16,920 be carried forward. He regretted that they were unable to recommend a dividend, but shareholders would

appreciate that, in the difficult times through which the industry was passing, it was undesirable that the cash resources of the company should be dissipated.

In viewing the operations of the year, it should be borne in mind that they had been working with a plant which was mainly new and incomplete, and that one unit was not even brought into operation till more than half the year had gone. The conversion of No. 1 dredge from steam to electric power was satisfactorily completed early in the present year, and they heard by cable last week that the elimination of the jigs, and the installation of tables on No. 2 dredge had also been completed.

In the opinion of the board, the present condition of the plant left nothing to be desired. They knew the tin contents of the ground to be satisfactory, and the only "fly in the ointment" was the present price of tin. The steps which had up to the present been taken to restrict output did not appear to have had the desired effect; but when general trade conditions throughout the world revived, there was bound to come an increasing demand for tin. The directors had thought it undesirable, in the interests of the shareholders, to accept the invitation for the company to become a member of the Tin Producers' Association.

The report was unanimously adopted.

GEEVOR TIN MINES, LTD.

Directors: St. John Winne (*Chairman and Joint Managing Director*), J. M. Iles (*Joint Managing Director*), J. A. Dennison, W. S. Leefe. *General Manager*: F. C. Cann. *Secretary*: E. J. Andrews. *Office*: Friars House, 39-41, New Broad Street, London, E.C. 2. *Formed* 1911. *Capital issued*: £164,250 in 10s. shares.

Business: Operates a tin mine at Pendeen, Cornwall.

The seventeenth ordinary general meeting of the Geevor Tin Mines, Ltd., was held at Winchester House, Old Broad Street, London, E.C., on Wednesday, June 4, 1930, Mr. St. John Winne (Chairman and joint managing director) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended March 31, last, said: Gentlemen, it has been customary at our meetings to take the reports and accounts submitted as read and I am assuming that you will do so on this occasion. With regard to the mine itself, you have, no doubt, already come to the conclusion that the report of our general manager, Mr. F. C. Cann, is very satisfactory, but the financial results, for reasons over which the board has had no control, are extremely disappointing, yet good under the circumstances.

I should like to explain the item of £4,373 3s. 3d. in the profit and loss account under the heading "Royalties, Rent, Rates, and Insurance." These have to be paid, though we may be unable to work at a profit. Under present circumstances these burdens are intolerable. If they were only chargeable on profits it would be a different matter. There is nothing else, I think, in the profit and loss account calling for special remark.

The appropriation account shows that during the year under review we have paid out by way of dividends £16,425, one moiety being the final dividend for the previous year and the other being the interim dividend on account of the year we are now dealing with, so the members have benefited to that extent. The result is that we show a profit balance of £6,564 11s. 5d., which it is proposed to carry forward.

The costs of the year have been satisfactory and compare favourably, I think, with other tin mines in Cornwall: Operating costs at the mine, 20s. 11 19d. per ton; royalties, rents, rates and insurance, 1s. 6 13d. per ton; London expenditure, 1s. 0 30d. per ton; making a total of 23s. 5 62d. per ton, and showing a reduction of about 1s. 9d. per ton against the previous year. Add to this for recoupment of development expenditure on ore extracted, 3s. 11 50d. per ton, gives an all-in total of 27s. 5 12d. per ton; converting these black tin figures into terms of metallic tin our output for the year was 527 tons and the all-in costs, including development work, £150 12s. per ton. The proved ore reserves are 169,996 tons, 21,405 tons greater than in the previous year. Taking as a guide the tonnage milled during the year this shows that the mine is in the happy position of being about three years ahead of the mill. Were we permanently experiencing a comparatively stabilized price for tin it would be easy, as well as interesting, to estimate the profit value of this large tonnage, but under present circumstances it would be waste of time.

On previous occasions reference has been made to a new tin recovery process I have interested

myself in at great expense, but at no expense to this company. This you may hear of again later on and I believe it will ultimately prove beneficial to your company. At the present time all attention is being centred upon, not how to improve tin supplies, but how to restrict them.

You have been informed that the company has become a member of the Tin Producers' Association (Incorporated) and that I have the honour of occupying a seat on the council. At an extraordinary general meeting of the members of the association, held in April last, it was unanimously resolved to endeavour to bring about a 20% reduction in the tin outputs, but it now appears that more drastic proposals must be brought forward to meet the present situation.

The Chairman then referred at length to the speeches of Mr. F. E. Mair and the meeting of Pengkalen, Ltd., and of Mr. John Howeson at the meeting of the Anglo-Oriental Mining Corporation. Continuing he said: I have observed how difficult it has been to bring all producers into line, particularly some of the low-cost producers. Mr. Howeson spoke of a production of 190,000 tons of metallic tin last year. Of this huge quantity it is reported in the May issue of the MINING MAGAZINE that the Cornish tin output in 1929 was only 5,612 tons of black tin—that is, say, 65% tin metal, or equal to, say, 3,648 tons of metallic tin. In comparison with the great total output I have mentioned the Cornish output is a negligible quantity and might be excused from any curtailment whatever but for the principle of the thing, and so I feel sure you will wish our company to play the game fully.

Now to come back to our affairs, tin now standing at the low price I have just mentioned has put us for the time being into a difficult position so far as keeping up the full complement of our work is concerned, but we shall weather the storm. We have taken this opportunity to reduce expenses and at the same time to do some useful work requiring attention. Under our plan a fair amount of development will be carried out and, even with the present price of tin, the manager is confident of being able to meet total costs. In short, we shall be dealing with the varying situations as they arise, at the same time conserving your cash resources, and be rendering, perhaps, more than our full quota to the objects of the Tin Producers' Association, which I am convinced should be supported. In other words, I want you to continue your confidence in the board, although it may be many months yet before we shall run into smooth waters again. You have a good mine, well equipped, and, with cash and liquid resources. Needless to say, we shall carefully safeguard the interests of our Credit Notes holders.

The resolution was seconded by Mr. J. M. Iles, and on being put to the meeting was carried unanimously.

OROVILLE DREDGING COMPANY, LTD.

Directors : F. W. Baker (*Chairman*), John A. Agnew, Lord Brabourne, H. C. Porter, R. Annan, W. H. Michael. *Secretary* : G. E. Hounsom. *Office* : 1, London Wall Buildings, E.C. 2. *Formed* 1909. *Capital issued* : £143,127 4s. in 4s. shares.

Business : Operates, through Pato Mines (Colombia), Ltd., alluvial gold property in Colombia.

The eighteenth ordinary general meeting of the Oroville Dredging Company, Ltd., was held on May 15 at Winchester House, Old Broad Street, E.C., Mr. Frederick W. Baker (Chairman of the company) presiding.

The Secretary (Mr. G. E. Hounsom) having read the notice convening the meeting and the report of the auditors,

The Chairman said : Ladies and gentlemen,— With your permission, I will ask you to treat the directors' report and accounts as read. The total of issued capital as at September 30, 1929, remains unaltered at £143,127 4s. During the period under review dividends were received from the company's holding of shares in the Pato Mines (Colombia), Ltd., amounting to £49,953 17s. 6d. and other credits in the profit and loss account amounting to £1,829 12s. 7d. From the total credits of £51,783 10s. 1d., after debiting all charges in London, expenses in Colombia and income-tax, the balance to the credit of profit and loss account for the period carried to the balance-sheet is £47,196 14s. 10d. Adding to this amount the credit balance from the previous year of £25,850 15s. 8d., a total is shown of £73,047 10s. 6d. Deducting from this the dividend of 1s. 3d. per share, amounting to £44,727 5s., paid on November 30, 1928, there remains a balance of £28,320 5s. 6d. After adding £15,853 4s., income-tax recovered, a balance of £44,173 9s. 6d. remains to the credit of profit and loss account as at September 30, 1929.

Before dealing with the annual report of field operations I would refer to the remarks made in my speech last year, where I referred to a decision which your directors had come to based on the fact that the gravel reserves at the Pato mines were gradually being exhausted, and they had thought it wise to recommend to you that all future earnings coming to us through our large holding in the Pato Company should be conserved, so that, should opportunity offer and on investigation we decided to acquire other gravel interests, either in Colombia or elsewhere, we should have a fund behind us which would enable us to acquire and, if necessary, equip any other property. I told you at last year's meeting that we were then in negotiation with owners in France and Italy who had extensive holdings in the neighbourhood of our Pato mines. As a result of these negotiations we secured an option on quite extensive gravel deposits, but I regret to have to inform you that the prospecting work done has disclosed values which would not have justified the acquisition of the properties. We have during the period under review looked into several other gravel properties, but have found nothing which, on the reports submitted, warranted investigation.

We have therefore decided, subject to your approval, to exhaust the remaining reserves of the Pato, which may keep us going for at least another

year, and, when our reserves are exhausted, liquidate the company and distribute to you the cash reserves and realized value of our plant and equipment.

In furtherance of the policy which I have just indicated, your Board decided at our last meeting to declare an interim dividend of 1s. 6d. per share, which will absorb profits amounting to £53,672 14s., made up of the balance to the credit of profit and loss as at September 30, 1929, the balance of £9,499 being made up from current year's profits. Dividend warrants will be posted to shareholders to-morrow.

I may mention that, in addition to the small reserve of gravel remaining, Mr. Watson, our manager, is proposing to carry out some tests for dredging some of the old tailings, and it is possible that we may earn a small revenue in hydrauliclicking some of the gravel benches on the property, though we are not looking for any substantial revenue to come from these sources.

In his annual report of field operations to September 30, 1929, the manager, Mr. A. T. Watson, states that 1,922,945 cubic yards were dredged by Pato No. 1 dredge, as compared with 1,912,377 cubic yards for the previous year, the gross value of the gold recovered being \$438,789, averaging 22.82 cents per cubic yard, against \$486,913, averaging 25.46 cents, for the previous year, the average depth dredged being 33.42 feet, as against 28.72 feet. Mr. Watson also states that Pato No. 2 dredge dredged 1,482,161 cubic yards, as compared with 1,140,425 for the previous year, the gross value of the gold recovered being \$192,985, averaging 13.02 cents per cubic yard, against \$201,758, averaging 17.69 cents for the previous year, the average depth dredged being 27.93 feet, as against 24.23 feet. The field cost for both dredges for the year averaged 9.44 cents per cubic yard, as compared with 11.13 cents for the previous year.

The accounts for the Pato Company for the year ended September 30, 1929, after providing for £5,000 for depreciation and £14,834 6s. for income-tax, show a profit of £40,140 14s. 1d. Adding to this the balance of £152,014 2s. 4d. from the previous account and deducting the dividend paid during the year a total of £152,154 16s. 5d. is carried forward at September 30, 1929.

As I have pointed out to you at previous meetings, this large carry-forward is not represented by cash, but consists mainly of profits invested in our power plant and equipment.

I now propose : "That the directors' report and statement of accounts for the financial year to September 30, 1929, be hereby received and adopted," and I will ask Lord Brabourne to second it. Before putting the resolution I shall be glad to deal with any questions which you may wish to put to me.

The resolution was put to the meeting and carried.

ANGLO-ORIENTAL MINING CORPORATION, LTD.

Directors : John Howeson (*Chairman*), Sir W. D. Henry, Hon. Lionel Holland, Richmond Temple.
Consulting Engineers : Yuba Associated Engineers. *Secretary* : D. T. Waring. *Office* : 31 and 33,
 Bishopsgate, London, E.C.2. *Formed* 1928. *Capital issued* : £1,250,000.

Business : Finance of and investment in tin mining and other ventures in various parts of the world.

The second ordinary general meeting of the Anglo-Oriental Mining Corporation, Ltd., was held on May 22, at the Cannon Street Hotel, E.C., Mr. John Howeson (Chairman of the company) presiding.

The Chairman, in moving the adoption of the report and accounts for the year ended February 28 last, said: A year ago I emphasised the grave consequences which must ensue if producers continued to add, as they were then adding, to the world's surplus stock of tin and, although I was able to indicate the beginning of a movement among producers towards sane and vigorous co-operation in the common cause, it was not until the end of 1929 that our hopes were fulfilled and the first practical steps taken to achieve the results we have so long desired and have worked so strenuously to bring about. It is encouraging to learn that the Tin Producers' Association should have obtained the support of producers representing more than 70% of the world's output of tin. Yet, while we may look forward with every confidence to the reduction of surplus stocks to a figure that will ensure a fair and reasonable price for tin, the present situation is serious and the need for expedition is imperative. The association needs, and, with all the emphasis at my command I say that it deserves, the firm and unequivocal adherence of every British producer.

Under the deplorable conditions now obtaining, the policy of regulation of output must for the present continue in the forefront of the programme of the Tin Producers' Association. You will appreciate that research work, although, indeed, most vitally necessary to the industry—because our ultimate objective must be to increase consumption, not to decrease production—is always slow to bring tangible results. You will also recognize that it is difficult for an industry threatened with pauperism and consequent demoralization to make available the substantial resources without which such research cannot be efficiently undertaken. We must, therefore, first proceed to put our house in order. Why should the producers of tin continue digging up and sending to market a tonnage definitely beyond that which the world at present needs and consumers are willing to absorb? Do the blast furnaces continue to work at full capacity when no more than 80% of the metal they produce is required? What possible justification can there be for squandering exhaustible resources? The theoretical law of supply and demand, of which so much is made, operates bilaterally; the extent of the demand is governed by the quantity which the tin-consuming industries can utilize, but producers, alone, determine the volume of the supplies they choose to dig up.

We have been producing collectively every month 500, sometimes 1,000 tons of tin in excess of the contemporary demands, which add so much more to the already excessive stocks, and so helps to defer for a still longer period the recovery of

which the industry stands in such need. Moreover, that relatively small quantity of surplus tin depreciates the selling value of the world's output and you will recognize that a depreciation of as little as £10 per ton on one month's production of 15,000 tons outweighs the entire proceeds of 1,000 tons of extra metal. Why should that unwanted tin continue to be produced, when every producer is penalised by its production? I would remind you that the average life of a tin mine is notoriously short, so that depletion or amortization is a serious factor in our industry. Taking into account amortization of the original investment, which cannot be ignored unless the investor is prepared to regard his capital as lost (or to calculate that so much of each dividend he receives is not in fact a dividend, but merely repayment of capital), it has been computed that the average all-in cost of the world's present output of tin is more than £180 per ton.

My excuse for enlarging on this subject is that the greatest confusion obtains in regard to this vital question of costs, due no doubt to the fact that quoted costs generally include only the actual costs at the mine. Take, for example, the case of a Malayan producer whose mining costs are stated as £75 a ton. If, as is most probable, those costs relate to the concentrates produced at the mine, which we may assume to assay 72% tin, then the cost per ton of tin would be £104. But this includes neither transport and smelting charges nor the export tax, which, with tin at £150, will in the aggregate reduce the price received for the metal by £30 a ton, or, if you prefer, increase the cost from £104 to £134 per ton of metal. Even then we still have overheads and amortization to take into account. It is easy, then, to see that mining costs at the reasonably low-sounding figure of £75 a ton do not necessarily imply a profit to the producer with tin at its present price; and although a number of the richer dredging propositions can and do mine their concentrate at a cost much below £70 a ton, there are also a great many, even among the favoured alluvial producers, for whom so low a cost as £75 is entirely out of the question.

There is also a good deal of idle talk about high-cost and low-cost producers, based upon a number of cardinal misconceptions. While it is most often the case that efficiency is indicated by the low yardage costs, profits depend essentially upon the costs per ton, so that many of the so-called low-cost producers (so-called because their profits make the best showing) are by no means the most efficient, although the inference that they are is indelibly fixed in the mind of the casual commentator. As, moreover, the majority of the alluvial areas now being worked on a large scale and with up-to-date plants are definitely low-grade—and these undoubtedly constitute the best-equipped and probably not the least efficiently managed enterprises—it follows that their tonnage costs will substantially exceed the tonnage costs of many of the older and richer areas, despite in the latter

case plant which may be out of date and perhaps no longer particularly efficient in operation. That, of course, is inevitable, but when the essential facts are misunderstood, it must tend to injure the whole industry.

The prospect of any marked reduction in the future of tonnage costs, which alone bear any just relation to price, is therefore extremely remote. It is so important to destroy the illusion that yardage costs are the standard for measuring the profits of the industry that I trust you will forgive this somewhat lengthy digression.

The prevailing lack of appreciation in this regard is directly responsible for the complete misunderstanding of the developments that have occurred within the last year or two in the Bolivian and Nigerian fields, and so induced a hesitancy among a number of Malayan producers at a time when the situation could have been remedied much more easily and quickly than may now be the case. The tonnage costs of the principal producer in Bolivia, who is also the largest individual producer in the world, have been so enormously reduced by accelerating output that these particular mines must now be included, at any rate, among the relatively low-cost producers, while, thanks to the introduction of hydro-electric power and modern mechanical plant, the cost of quite a considerable proportion of the Nigerian output ranks at the present time with the lowest in the world. The total eclipse of these fields, which at one time was freely predicted at a price of £200 a ton, has therefore not materialised even with tin at £140.

And now, before I finally leave the subject of regulation, let me say that I can discern only one alternative to the programme of the Tin Producers' Association, and that is to leave matters alone and so encourage each producer to pursue his own course. Without any check upon over-production, stocks would continue to mount up and prices to fall until sufficient producers are temporarily driven to the wall. But that, let us make no mistake, would be a slow, hard and costly process, and, moreover, this method of eliminating the surplus producer could only end, as it always has ended, in a shortage of production, thus stimulating renewed speculation, which would drive prices again to dangerous heights, turn consumers' minds to the finding of substitutes, and so work incalculable harm to all producers. Stability, the prime need of the industry, would then be more remote than ever.

In regard to the accounts you will have observed that the net profit for the year of £96,465 represents, after deducting the fixed preferential dividend, earnings equivalent to approximately 15% on the Ordinary capital of the corporation. We have, however, asked you to approve on this occasion the modest distribution of 3d. per share to the Ordinary shareholders, which absorbs £9,687, and entitles the Preference shareholders to participate to the extent of an additional penny per share, to transfer £25,000 in all to reserves, and to carry forward to next account £82,042, a sum that covers our liability in respect to Preference dividend for the whole of the year 1930-31, and leaves £22,000 over.

This concludes my detailed review of the accounts, but in view of our paramount interest in London Tin Corporation, you will perhaps wish me to

enlarge a little further upon the potentialities of that particular business. London Tin Corporation is the largest shareholder in Associated Tin Mines of Nigeria, a consolidated enterprise, capable of producing as much as 400 tons a month, but still able to make a profit on half that output, to which basis production is at present being regulated. In Malaya, London Tin Corporation is intimately identified with the Anglo-Malayan confederation of Kinta Valley Dredging companies, and is also associated with the well-known alluvial group operating in the Rawang district and elsewhere. In addition, the corporation has a predominating interest in the very extensive areas owned by Lower Perak Tin Dredging, Ltd., and has interests of varying proportions in production throughout the Federated Malay States, Siam and Burma. The corporation is also a shareholder in Consolidated Tin Smelters.

I have left Cornwall to the last, because the Cornish lode mines, in which London Tin Corporation has a not inconsiderable interest, live in the past, as I make no doubt they will again in the future. Under the existing conditions those mines cannot be profitably exploited, and they should therefore be regarded merely in the light of reserves.

Perhaps it will save time, and also prove more convenient, if I refer now to the extraordinary meeting which has been convened to follow immediately upon the termination of this present meeting. Our purpose in calling that meeting is to obtain your authority to increase the authorized Ordinary capital of the corporation by £250,000. Although the negotiations mentioned in the circular have not yet been carried to a successful conclusion, and I am not at the moment at liberty to refer to them more specifically, we felt that they were likely to mature at an early date and were therefore anxious to avoid summoning you to attend a second meeting at an interval that will probably not exceed at the most a few weeks.

And now, in conclusion, a brief word on the present outlook. Our principal consumer, as you know, is the tinplate industry. It is therefore encouraging to note that the production of tinplate has more than doubled since 1922. Adverting to the motor industry, it is worthy of note that the world registrations increased in 1929 by 3,173,000 units, the greatest yearly increase since 1926.

In considering the potential production and sale of cars in America, it is well to remember that the active life of a car in that country certainly does not exceed seven years, and is usually much shorter—so that at least 3,000,000 of the 24,000,000 motor vehicles now in use in the United States must be replaced every year. Taking everything into consideration, the prospects of consumption are by no means discouraging. As to production, the industry has had its lesson, for which a very high price has been paid.

The Chairman concluded by moving the adoption of the report and accounts, and the payment of the dividends recommended.

The motion was carried unanimously.

At an extraordinary general meeting which followed it was unanimously resolved: "That the capital of the company be increased from £1,500,000 to £1,750,000 by the creation of 1,000,000 new Ordinary shares of 5s. each."

Professional Directory

ADDICKS, Lawrence,
Consulting Engineer,
Bel Air, Maryland, U.S.A.
Cables: Galia, New York.

BEST, James P.,
Mining & Mechanical Engineer
(Alluvials),
P.O. Gudi, Plateau Province, N. Nigeria.
Code: Broomhall.

AGNEW, John A., Tel.: Metropolitan 7751.
49, Moorgate London, E.C.2.
Cables: Lingulina, London.

BEWICK, MOREING & Co., Tel.: Metropolitan 2655.
62, London Wall, London, E.C. 2.
Cables: Bewick.

AGUILAR-REVOREDO, J. F.,
Mining Engineer,
Casilla 900, Lima, Peru.

BLACKMAN, H.,
Mining and Structural Engineer,
Explorations, Examinations, and Development in Canada.
Room 523; 276, St. James Street, Montreal, Que., Canada.

ALDRIDGE, Walter H.,
Mining and Metallurgical Engineer,
41, East 42nd Street, New York.

BOISE, Charles W.,
Mining Engineer,
Foreign Exploration,
Room 1507-14 Wall Street, New York.
Cables: Mukeba.

ALLAN, Clyde,
Mining Engineer,
P.O. Jos, Northern Nigeria.

BOTSFORD, R. S.,
Mining Engineer,
Fraser Brace, Ltd., Medellin, Colombia, S. Am.
265, Gresham House, London, E.C. 2.

ANDERSON, Robert J.,
Consultant on Aluminium Metallurgy,
16,200, Hilliard Road, Lakewood, Cleveland,
Ohio, U.S.A.

BOYD, Julian,
Consulting Mining Engineer,
1014, Central Building, Los Angeles, California.
Cables: Boydite.

ASHCROFT, Edgar A.,
Consulting Metallurgist,
New Methods in Metallurgy.
Waye House Laboratories, nr. Ashburton, S. Devon.
Cables: Nutalg, Ashburton.

BOYDELL, H. C.,
Mining Geologist and Engineer,
310, McKinnon Building, Toronto, Canada.
Cables: Husky.

BANKS, Charles A.,
Mining Engineer,
Pacific Building, Hastings Street, W.,
Vancouver, B.C.
Cables: Bankca. Code: Bedford McNeill.

BOYES, H. H. W.,
Messrs. FOLEY, BOYES, BUTLER & PEEK,
Consulting and Mining Engineers,
P.O. Jos, Northern Nigeria.
Cables: Foyes, Jos. Codes: Bentley, Broomhall.

BARRY, John G.,
Consulting Mining Geologist and Engineer,
609, Mills Building, El Paso, Texas.
Cables: Bargo. Code: Bedford McNeill.

BROADBRIDGE, Walter, Tel.: Metropolitan 6144.
Consulting, Mining & Metallurgical Engineer,
Minerals Separation, Ltd., 62, London Wall, E.C. 2.
Cable: Rillstope, London.

BARTON, Donald C.,
Consulting Geologist and Geophysicist
Specialist: Eotvos Torsion Balance.
Petroleum Building, Houston, Texas.

BRODIE, Walter M.,
Mining Engineer and Metallurgist,
1807, Phelps Place, Washington, D.C., U.S.A.

BEATTY, A. Chester,
25, Broad Street, New York.
No professional work entertained.

BROOKS, Raymond,
Mining Engineer,
15, William Street, New York.
16, Colonial Mutual Bldgs., Johannesburg.
Cables: Brookray, New York and Johannesburg.

