The Mining Magazine

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EDITORIAL

TEN gold medals have been presented to the Canadian Institute of Mining and Metallurgy by the Hon. Randolph Bruce, Lieutenant-Governor of British Columbia, one medal to be awarded annually, if thought fit, to the member or members making the most notable contributions to advancement in the fields of mining, metallurgy and geology. Such medals when awarded will be known as the "R. Randolph Bruce Gold Medal."

CONTINENTAL drift hypotheses, although belonging properly to the realm of pure, or rather speculative, geology, have yet an economic significance, inasmuch as they admit of the possibility of prognosticating mineral occurrences. In this issue we publish the first part of an article by Professor Arthur Holmes, in which he expounds, for the benefit of mining engineers, the presently-held views of geologists on this vexatious question. Simultaneously we publish extracts from an address by Dr. A. L. du Toit, an independent advocate of the theory, and from a paper by Dr. Ernest Parsons which also bears on the subject.

THE annual dinner of the Institution of Mining and Metallurgy was held in London on April 10 under the chairmanship of the President, Professor S. J. Truscott, when speeches were also delivered by Sir Halford Mackinder, Chairman of the Imperial Economic Committee, Sir Godfrey Fell, Sir Auckland Geddes, Sir Richard Gregory, and the President-elect Dr. William Cullen. The Gold Medal of the Institution of Mining and Metallurgy has been awarded conjointly to the Hon. W. L. Baillieu and W. S. Robinson "in recognition of their services in the development of the mineral resources of the Empire, with special reference to the zinc and lead industries of Australia." The medal (in duplicate) will be presented at the Annual General Meeting of the Institution on May 16.

The Institution and Geophysics

The object of the March meeting of the Institution of Mining and Metallurgy was to afford members an opportunity of hearing the elementary principles underlying the more important known methods of geophysical prospecting, on which there is, be it said however, considerable literature already available. Papers were presented by Captain H. Shaw and Mr. E. Lancaster-Jones respectively on magnetic and gravimetric methods. Dr. W. F. P. McLintock, of the Geological Survey of Great Britain, also read a paper on the latter subject. Professor A. O. Rankine, of the Department of Physics in the Imperial College, gave a clear exposition of the seismic method, about which not so much, perhaps, is known in this country. The names of the first two authors are already well known to readers of the MAGAZINE, which has published articles written jointly by them on the Eötvös balance.

After dealing with the elements of magnetic methods, Captain Shaw referred to the limitations of this system. Thus in fields not uniformly magnetic the interpretation of results obtained can often be illusory and, if the method is to be developed for the location of weak anomalies, a further increase in reliability and accuracy of the instruments employed is required. Apart from this, magnetic methods have the advantage of being the least costly. It is possible for two men to cover one square mile in 8 to 10 days at a cost of about £150 a month. A prolonged survey in the United States cost £1,500 a year.

Dr. McLintock in the course of his paper referred to the two geophysical surveys carried out by the Geological Survey of Great Britain. The first of these, that over the Swynnerton Dyke, formed the subject of an article in the MAGAZINE for December, 1927, and the second, which was the subject of a paper before the Royal Society of Edinburgh in November last, appears in abstract form elsewhere in this issue. He also showed a sketch map giving some results of yet another survey, also in Scotland, which will be recorded in the Summary of Progress, Part II, 1928. He was of opinion that the literature of geophysics is not good, and that it might be much enriched by the publication of details of further surveys. This afforded him the opportunity of complaining against the secrecy shrouding the operations of the various commercial enterprises which have sprung up for the exploitation of the new art.

Gravitational surveying was reviewed by Mr. Lancaster-Jones in quite general terms, which showed how both surface and subdrift topography affected results obtained by the Eötvös balance. In fact, he frankly pointed out the difficulties, but anticipated

adverse criticism by indicating that the cost of the survey by this method had to be considered in conjunction with the degree of success obtainable when comparing it with other methods. His figures were £500 per month for 100 stations over an area of one square mile, in addition to the first cost of the instruments at £1,000 to £1,500 each, of which five or six would be required. In defence of these costs as compared with those of drilling it must be remembered that the result obtained is three-dimensional rather than uni-dimensional. Interest will doubtless centre on the foreshadowed use of torsion balances underground for finding orebodies which have " petered out."

Professor Rankine is to be congratulated on covering a great deal of ground in a very short time. The attentive listener came away with a clear idea of exactly how a seismic survey is carried out, even to the major details of interpreting the results obtained. As to the place to be taken by this method in the geophysical scheme, its great advantage is the relative rapidity with which results are obtained. Thus speed is more important than accuracy in this case, especially if this method be regarded as the pioneer to be followed if necessary and possible by another method—e.g. torsion balance—for confirmatory purposes. In the future some increased accuracy in the method may be looked for since there are circumstances, notably those associated with the location of deeply-buried structures, where this method and this alone can be used.

The views of Sir John Flett, Director of the Geological Survey of Great Britain, were in the nature of an expression of his interest in the matter from the first and of a determination that this country should not be behind others—a zeal, he confessed, that was fired largely by the proceedings at the Geological Congress in Madrid, in 1927. Hence the surveys to which allusion has been made above, which, it will be noted, have been carried out over areas the geological structure of which was already thoroughly well known to the Survey. The prime object of the work was thus to establish the value or otherwise of the claims advanced on behalf of gravitational methods. Particularly important was his emphasis of the fact that geophysics is to be regarded only as introductory to the good old-fashioned methods of locating orebodies; that it is but an indicator, albeit one the accuracy of which may become considerable. Mining engineers will not be certain until, by boring, sinking, driving, and exploring, the ore is produced to the light of day!

Professor Truscott, when introducing the subject, took the opportunity of welcoming Mr. Hans Lundberg, the eminent Swedish geologist and geophysicist, of whose views it was unfortunate that time did not permit members to have the advantage. Want of time also necessitated the deferment of Mr. Broughton Edge's paper, which was, however, perhaps, an advantage, as the author was absent and may be present at this month's meeting.

Copper and Tin

Among base metals copper and tin are probably the centre of the greatest interest. Spectacular price changes have of late been witnessed in the former, while the latter has for long been the source of mental if not of actual financial speculation. Considering first the position with regard to copper, it is not so very many years since the market for that metal languished, with ever-present fears of over-production. Consequently after the big post-war boom of 1920 values slipped away and cash standard copper, which had averaged £98 in that year, dropped in 1927 to an average of £56. The circumstances which produced that fall were also instrumental in bringing about the formation of the organization known as the Copper Exporters Inc. to handle the United States producers' export business in copper, and, although that body commenced to function in the latter part of 1926, considerable time elapsed before its existence became apparent in the market. Subsequently another organization, the Copper Institute, was created, which, however, confined its activities to the United States home trade, and through which it was intended that the producers should be kept in close touch with the general position of the industry, and thus presumably be able to regulate supplies to demand and bring about uniformity in prices.

It is no doubt largely due to the operation of these two organizations that the remarkable advance in copper prices is to be attributed, although, of course, their efforts would have been futile but for the equally remarkable expansion witnessed in consumption. This increase can best be visualized by scrutinizing the American

deliveries of refined copper for the domestic and the export markets. In 1924 these combined totalled 1,319,783 short tons, whereas in 1928 they amounted to no less than 1,657,681 short tons. It is probable, however, that this factor alone would not have brought about the enormous improvement in copper values which has actually been seen, for the simple reason that without the restriction imposed upon competitive selling by the organization of the Copper Exporters Inc. it would not have been possible for the producers to reap the full advantage of the improved situation. Last year the deliveries actually exceeded the production of refined copper, so that the American stocks, which after all form the keystone of the situation, were reduced from just over 95,000 tons to a little over 65,000 tons, a drop of close upon 30,000 tons. That there was justification for a substantial improvement in the selling prices is, therefore, obvious, but whether it warranted the tremendous advance which has been seen is a very different matter. As time went on, however, it became obvious that producers were in control of the position and, with consumption active everywhere, users apparently became apprehensive and hastened to cover their requirements both present and prospective. Full advantage was taken by the copper producers of this buying movement. Their action, indeed, served to stampede buyers and prices were advanced again and again, each successive rise only accentuating the fears of consumers and the cupidity of producers.

The whole movement was no doubt cleverly engineered and was most acceptable to mining and smelting interests, though the same can hardly be said from the consumers' standpoint. Unduly high prices end by checking the development of consumption and a very large absorption is necessary if to-day's big output of copper is to go on being used as soon as it is produced. Electrical developments have been the mainstay of the market, which is illustrated by the fact that of the American deliveries about 60 per cent. are in the shape of wire bars, used for wire drawing. Latterly the demand from consumers has subsided, whilst offers of copper for re-sale have made their appearance everywhere. The sharp drop in standard which ensued when it was unmistakable that the demand for electrolytic had eased off gave evidence that the rise had been altogether overdone, but there is equally the danger that the fall may go too far, especially with the stocks of standard dangerously small. It is to be hoped, however, that the market will be permitted to settle down at a reasonable level without further violent reactions. In the long run "Alice in Wonderland" markets such as have been seen lately in copper are positively harmful to all concerned.

Turning to tin, this market recently has not displayed such wide fluctuations as that for copper, and, indeed, for some other metals, but nevertheless values have been maintained wonderfully well during a period when flabby and nervous conditions might easily have been experienced. A year or two ago the shortage of tin caused by the failure of production to respond adequately to the increased calls for the metal resulted in excessively high prices, cash standard averaging over £291 in 1926. Eventually production was pushed up everywhere, whilst dozens of new companies were formed to exploit fresh areas and open new mines. The result of this broad influx of new capital was a steady expansion in production, alike in the Federated Malay States and other important producing centres, the world's output in 1928 being estimated at about 171,800 tons, compared with about 153,500 tons in 1927 and 141,000 tons in 1926. In face of this increase it was obvious that consumption would need to broaden if the scarcity of metal and the resulting excessively high prices were to continue, but apparently it failed to do so at a rate equal to that of the expansion in output, which is clearly evidenced by the fact that during the year 1928 the visible supplies expanded by fully 8,000 tons. Even this 8,000 tons does not tell the whole story, for a large quantity of tin is known to have been dealt with by the holders in such a way that it does not appear in the recognized trade statistics. The remarkable activity of the motor car industry is responsible for a heavy consumption of the metal, whilst the increased use of tin containers accounts for the absorption of additional quantities in the tinplate industry, the growth in both directions being largely in America. In face of the increased output and the growing visible supplies the inference is irresistible that prices would have declined to below £200 but for the persistent support rendered to the market in recent months by what is popularly known as the "group." The composition of this group is a jealously guarded secret, although it is generally believed that its members are closely

associated with large producing interests and have Stock Exchange and possibly banking affiliations and connections. Whoever they may be, however, they evidently take the view that sooner or later consumption will increase sufficiently to absorb the whole mine output, and, believing that it is only a question of time before the present apparent surplus will all be required, have laid their plans to control the entire producing and consuming ramifications of the industry, and also to dictate prices to the world. Time will show whether they have read the future and their own abilities correctly. Meantime tin prices are very profitable to most mines and the " group " operations have been of great benefit to the mining industry.

Petroleum Economics

Space has been devoted in these columns from time to time to a consideration of some of the broader aspects of the economics of petroleum, both from the point of view of the use of the refined products as fuels and lubricants and from that of the part played by mining engineers and technologists in the production of the raw material. The time is opportune for a review of the field on account of two recent events. We refer respectively to the declaration that any restriction of output in the world's largest producing country would be contrary to the Sherman Anti Trust law and to the death of Karl Benz. The latter event affords opportunity for a retrospect, the former for a peep into the future.

Herr Karl Benz was virtually the co-founder of the automobile industry, having been until lately the head of the motor manufacturing business in Germany that bears his name. There can be no doubt that the perfection of our modern civilization—if such it be deemed—is largely due to the petrol engine and its big brothers the Diesels. The growth of these industries has definitely and fundamentally affected the production, not only of petroleum, but also of coal, to say nothing of such alloy metals as tin, copper, lead, zinc, and aluminium.

Turning now to the position in respect of the supposed existing attempt to control and even reduce the output of crude petroleum, as already pointed out the existing law in the United States prevents inter-State agreements and any change must be accompanied by the Federal regulation of prices, to which course the present administration is opposed.

A curious inversion has taken place. When crude oil was first obtained by drilling, the white spirit distillate was a waste product, being burnt in vast quantities to get rid of it. Now, however, such is the number of petrol engines, the opposite state of affairs exists and the industry often has difficulty in finding markets for the heavy fraction, chiefly fuel oil, and this in spite of the continued advances in the development of the heavy-oil engine. This want of balance in the marketing of the products derived from the refining of crude petroleum is stated to be the prime cause of the fluctuations in prices, particularly those of motor spirit.

Two factors, we think, are eventually going to prove decisive—the rate of the approaching exhaustion of present prolific producing areas and the rate of improvement in methods for the manufacture of spirits and oils from coal, be they from carbonization or hydrogenation processes.

That a virtual control of crude oil output on the other side of the Atlantic, in face of the above-outlined considerations, is still possible may be readily appreciated if the metal copper be taken as an analogue. At present America controls the world's copper market, being the largest single producing unit. The copper producing fields in the States are widely disseminated and the Sherman laws prevent inter-State agreements ; yet all products are disposed of through one clearing house, which acts like a valve for the whole industry. Perhaps a similar exporting organization for oil in agreement with other world producers may eventuate.

Finally, a word of warning. Control of a commodity generally means a rising price. That substitutes for petrol have already been thought of is clear and competent authorities have prophesied the use of suction gas for all heavy motor vehicles in years to come, as Dr. Murray Stuart pointed out in his article dealing with the recent Fuel Conference, in our issue of November last. Furthermore, the displacement of fuel oil for steam raising in ships is a probable outcome of the advances made and contemplated in pulverized coal firing. It is as well, therefore, to bear in mind that any concerted action which results in an appreciable increase in the price of oil may operate to the ultimate disadvantage of those responsible for it.

REVIEW OF MINING

Introduction.—During the past month trade has continued quite good, being helped by the closing of the national financial year with a larger surplus than had been anticipated. Some attention has also been given to the final report of the Balfour Committee on Industry and Trade, which among other things favours Imperial Preference and the judicious application of Safeguarding. Among metals copper, lead, and zinc have all had spectacular increases, but they have not been retained. As to tin, this is lower, although the latest figures from the United States show an increase in the deliveries for March.

Transvaal.—The output of gold on the Rand during March was 830,829 oz. and in the outside districts 35 700 oz., making a total of 866,529 oz., as compared with 778,559 oz., 36,725 oz., and 815,284 oz. respectively for the previous month. The natives employed at the gold mines at the end of the month totalled 197 646 as compared with 196,150 at the end of February.

The Rand Mines report for 1928 shows a profit of £526,190, from which dividends totalling 100 per cent. have been paid, absorbing £511,288. With regard to investments, the report shows that a substantial holding in Trinidad Leaseholds has been acquired and that the company is also largely interested in the North Venezuelan and Tocoyu companies.

The Union Corporation profit for last year was £428,582, as compared with £386,160 for 1927, again establishing a record. A final dividend of 3s. 6d. a share, making 5s. 6d. for the year, is to be paid, as against 5s. for 1927. The reserve has been increased by £146,356, of which £30,000 is from last year's profit, the amount now standing to the credit of this account being £630,570.

The Premier Diamond report covering the year to October 31, 1928, states that the company resumed its deliveries as from January 1 of that year, its sales to the close of its financial year realizing £878 541. The profit for the year was £356,821, divisible between the Government and the company. Two dividends totalling 12s. 6d. were paid on the preference shares, which absorbed £100,000.

Cape Colony.—Reference was made last month to the proposed formation of an important manganese company. Further particulars of this undertaking are given by our South African correspondent in his letter appearing in this issue. The position of the proposed railway to connect this property with the existing line is indicated in the map on page 210.

Rhodesia.—The gold output of Southern Rhodesia for February was 44,551 oz., as compared with 46,231 oz. for January. Other outputs for February were :—Silver, 6,403 oz. ; coal, 60,796 tons ; asbestos, 992 tons, and mica, 12 tons.

To carry out plant extensions to meet the anticipated additional demands for fuel during the next few years the authorized capital of the Wankie Colliery Company has been increased by £100,000 to £1,100,000, in 10s. shares.

In view of the unsatisfactory course of developments on the Shamva, arrangements were made with Dr. Malcolm Maclaren—who reported on the property some four or five years ago—to visit the mine again. Summarizing Dr. Maclaren's report, it is stated that, whereas the prospecting work in the last two or three years has proceeded in the expectation that the Shamva orebodies were pitching westwards, the development in the deeper workings on the No. 10 level has shown this view to be in all probability erroneous and that the ore shoots are pitching in an easterly direction. Dr. Maclaren has, therefore, indicated the nature of the development work that should be carried out and it is to be proceeded with without delay. As he points out, two further years' life are indicated in any case, the prolongation thereof being dependent on the results of the exploratory work recommended, and he adds that nine months of intensive prospecting should be sufficient to show whether the orebodies persist eastward in depth.

West Africa.—Reporting to the Governor of the Gold Coast Colony on the principal points of economic interest emerging from the activities of the Geological Survey in 1928–29, Sir Albert Kitson refers to the confirmation by Dr. Cooper of the existence of large deposits of good bauxite 45 miles west of Kumasi, in the Yanahin district. These are estimated by Dr. Cooper to contain about 180 million tons of good ore. Reference is also made to the discovery

by Dr. Cooper of manganese ore of fair grade among the bauxite deposits. The possibility of providing hydro-electric power to work this area is stated to be under consideration.

Australia.—The gold outputs of all the Australian States for which statistics are available showed decreases last year, the comparative figures being as follows :—

	1927. oz.	1928. oz.	Decrease. oz.
Western Australia .	408,552	393,405	15,147
Victoria . .	38,620	34,000	4,620
New South Wales .	18,032	12,831	5,201
Queensland . .	36,411	12,080	24,331

Perhaps the foregoing is to some extent responsible for the announcement of the Commonwealth Prime Minister, that it has been decided to make available the sum of £250,000 for the assistance of the Australian gold mining industry.

At the beginning of last month a start was made with the Wiluna Railway, which is being constructed by the Western Australian Government, and it is expected to be completed not later than the end of November. In the meantime developments on the Wiluna mine continue to be of an encouraging character.

It has been decided by the directors of the Lake View and Star, in view of the vigorous development programme which is being undertaken in the Horseshoe section, to discontinue driving south into the Chaffers lease for the present at levels other than the 2,770 ft. and 3,140 ft. At the latter level a drive has been started south from the boundary and driven 16 ft., the first 5 ft. averaging £8 10s., the next 6 ft. £20, and the last 5 ft. £13, in each case over a width of 72 inches.

Last month news came to hand that owing to earth tremors the main shaft of the South Kalgurli had been damaged between the 1,350 ft. and 1,500 ft. levels, which would have the effect of reducing the output and grade of ore treated during the next three months, by which time it is estimated the repairs will be completed and the shaft put in good order again. It is to be hoped this unfortunate occurrence will not in any way interfere with the dividends, for this is the only undertaking which has for some time past regularly represented Western Australia in the dividend paying list.

The higher metal prices are causing some of the Broken Hill mines which suspended operations to think about reopening, this particularly applying to the Block 14—which suspended operations owing to the low price of metals about 18 months ago—and the Junction North.

For the half-year to December 31 last the Broken Hill South treated 163,600 tons of ore, assaying 14·2% lead, 6 oz. silver, and 11·7% zinc. The lead concentrates produced were 32,988 tons, assay value 62·2% lead, 27·1 oz. silver, and 6·7% zinc, and the zinc concentrates 31,983 tons, assay value 2·2% lead, 1·7 oz. silver, and 49·3% zinc. The estimated surplus for the half-year was £140,000.

Tasmania.—Torrential rains and the bursting of a dam have resulted in great damage and serious loss of life to the mining township of Derby. Latest news is to the effect that fourteen have perished, including the assistant manager and eight employees of the Briseis mine, and the general manager cables that the plant is destroyed and the workings flooded.

India.—The Champion Reef report for 1928 states that 111,162 tons of ore was milled, the total gold output being 63,337 oz. The net income for the year was £261,596 and working costs aggregated £222,475, leaving a profit of £39,121, against £40,934, whilst the dividend is 1s. per share, against 9d. for 1927. The ore reserves at the end of 1928 were estimated at 269,356 tons, an increase of 9,135 tons.

The Ooregum report for 1928 states that 150,000 tons was milled, the gold output amounting to 90,830 oz. For the year the net income was £374,061 and working costs £274,134, leaving a profit of £99,927. The final dividend of 1s. on the preference and ordinary shares makes the total for the year 2s. 9d. and 1s. 9d. per share respectively, or 5% below 1927. The ore reserves at the end of 1928 were estimated at 295,133 tons, a decrease of 58,201 tons as compared with the end of the previous year.

Burma.—In order to comply with the terms of the lease under which the Burma Corporation, Ltd., holds its property—which specifically require that it shall remain under British control and that certain of its officers must be British—it has been found necessary to effect certain alterations in the articles of association. For this purpose a meeting of shareholders has been called for the 15th inst.

Malaya.—So as to finance the completion of the erection of the dredge on the Hongkong Tin property the 40,000 reserve

shares have been offered to the shareholders at 10s., in the proportion of one new share for every complete fourteen old shares.

Canada.—Last year the mineral production of Canada reached the new record of $273,446,864, or $26,090,169 ahead of the 1927 figures. The gold output was 1,891,000 oz., value $39,091,000, an increase of 2·1% in quantity and value, whilst the copper production was 202,000,000 lb., value $28,488,000, an increase of 44·1% in quantity and 65·7% in value. The outputs of nickel, lead, zinc, and asbestos were all higher, but the production of silver at 21,922,000 oz. was lower.

With regard to the copper refinery to be jointly constructed by the Consolidated Mining and Smelting Company and Ventures —to which reference was made last month— it is now stated that Sudbury, Ontario, is the proposed site for this.

Among the papers read at the annual convention of the Canadian Institute of Mining and Metallurgy, which, as mentioned last month, was held this year at Winnipeg, was one on exploration work by aeroplane, Mr. John Hammell, the president of the Northern Aerial Mineral Exploration Company, describing their first year's work. A total of 100,000 miles of flying was done, resulting in numerous properties, of which particulars were given, being discovered. The plan adopted was to divide the country into districts under engineers, setting down prospectors at likely spots and maintaining daily or weekly contact with them.

United States.—An official intimation was made last month to the effect that the Arizona Copper Company had sold their complete interest in America to the Phelps-Dodge Corporation, the amount involved being put at about three million sterling. At a meeting on the 10th inst. it was decided to put the company into voluntary liquidation. An interim distribution of 40s. per share is to be made about May 21.

Venezuela.—To provide funds for plant and intensive development work, and possibly to acquire additional properties, the capital of the Bolivar Venezuela Gold Mines has been increased from £600,000 to £1,000,000, in £1 shares.

Spain.—The net profit of the Tharsis Sulphur and Copper Company for 1928 was £122,029, which compares with £73,088 for 1927, the dividend being 10 per cent., against 8¾ per cent. A general reserve fund has been created with an allocation of £25,000, to which the £10,000 standing at credit of reserve insurance fund account is also to be transferred, the carry forward being £82,139, against £85,110 brought in. A new lode is stated to have been discovered to the north, but its full extent cannot be gauged at the present stage of development.

Portugal.—Owing to the improvement in the price of wolfram, it has been decided to re-open the wolfram mine of the Beralt Tin and Wolfram Company. In the course of his report the company's consulting engineer states that a large tonnage of payable ore has been exposed and at the present price of wolfram he estimates a profit of £20 per ton.

Roumania.—It would seem that the present Roumanian Government has recognized the necessity of outside assistance if her mineral resources are to be developed, a measure under which foreign capital will be on the same footing as Roumanian capital in the development of the mines having been approved. Certain restrictions are, however, still to be imposed with regard to administration and labour and it remains to be seen how these will work.

Consolidated Mines Selection.—The profit for 1928 of £79,836 compares with £63,164 for 1927. The dividend is maintained at 20%, which will absorb £100,750, to meet which £22,000 is transferred from dividend equalization account, against £30,000 the previous year. This account now stands at £18,000.

Chemical and Metallurgical Corporation.—A number of changes have been recently made in the management, Dr. E. T. Andreæ having been elected chairman in place of Sir Frederick Mills, who has resigned owing to pressure of work in other directions, whilst Mr. Francis Arnatt has been appointed joint managing director to act with Mr. Stanley Smith. Mr. Walter McDermott and Mr. Atkinson Adams have also left the board on account of the increased calls on their time.

Petroleum.—The estimated world production of crude petroleum for 1928, based on information obtained from official sources, is 1,322,896,000 barrels, as compared with 1,261,073,000 barrels for 1927. The greatest increase is in the production of Venezuela, which from 63,134,000 barrels for 1927 has jumped to 106,000,000 barrels for 1928. In nearly every other country the production has also increased, the principal exception being Mexico, which shows a decline of 13,971,000 barrels.

A REVIEW OF THE CONTINENTAL DRIFT HYPOTHESIS

By ARTHUR HOLMES, D.Sc., A.R.C.S., F.G.S.
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The author discusses the Wegener hypotheses and some possible causes of continental drift.

Late in 1926 a Symposium on Wegener's theory of continental drift was held in New York by the American Association of Petroleum Geologists. In the course of a spirited and fruitful discussion some of the leading geologists of America and Europe expressed their considered opinions on an extremely complex group of problems, and the Association has now happily made these contributions available to a wider audience (**1**). Meanwhile Dr. A. L. du Toit, an independent advocate of continental drift, had completed a report on a comparative study of South Africa and South America made possible by five months intensive work in Brazil, Argentina and Uruguay (**2**). Still more recently in his Presidential Address [1] to the Geological Society of South Africa, du Toit has compared these two land masses from the point of view of metallogenic provinces (**3**). Finally, Mr. E. B. Bailey in a masterly address to Section C of the British Association at Glasgow has given us an unrivalled comparative study of the Palæozoic Mountain systems of Europe and America (**4**). The time is therefore opportune, not only for a review of these publications but for a general survey of all the relevant data and hypotheses.

THE WEGENER HYPOTHESES.—Advocates of the Wegener group of hypotheses assume that during Palæozoic time the continents were assembled together more closely than they are at present. Antarctica, Australia and India were grouped against southern and eastern Africa, and these, with South America against western Africa, formed a single large continent—a compressed equivalent of the more familiar *Gondwanaland* of orthodox geology. Similarly, in the north, North America and Greenland formed with Europe and Asia a continental block which has since become known as *Laurasia*. To the combinations of these two, Wegener gives the name *Pangæa*: his conception of it is illustrated in Fig. 1.

FIG. 1.—WEGENER'S CONCEPTION OF THE WORLD IN THE CARBONIFEROUS PERIOD.
Heavily shaded portions indicate deep seas; horizontal lines shallow water; unshaded portions dry land.
Reproduced from DISCOVERY, *May*, 1922, *by courtesy of Messrs. Benn Bros., Ltd.*

[1] Abstracts appear elsewhere in this issue of the MAGAZINE.

It will be observed that in this unfamiliar looking map the South pole is situated near Natal ; a second assumption is therefore that there have been extensive geographical changes in the position of the poles. The present distribution of the continents is regarded as a result of fragmentation by rifting, followed by a drifting apart of the blocks ; Gondwanaland having broken up during the Mesozoic, and Laurasia during the Cainozoic. The continental blocks are visualized as slabs of granitic and gneissose rocks which, being rich in *si*lica and *al*umina are mnemonically referred to as *sial*. The blocks of sial " float " in a substratum of basic or ultrabasic rock which, being characterized by *si*lica and *mag*nesia is called *sima*. The lighter sial of the continents projects on an average nearly 5 km. above the heavier sima of the ocean floor. The two chief forces to which Wegener appeals to engineer the drifting process are differential gravitational forces which act on the protruding blocks of sial. They are respectively (*a*) the Eötvös *pohlflucht* or equatorial drift tending to move the continents towards the equator ; and (*b*) a westward drift of the continents due to tidal friction.

The equatorial drift is illustrated by the relative approach of Africa and Europe and by that of Peninsula India and Asia. Previously, for long geological ages, these more stable regions had been separated by an unstable, steadily down-sinking belt, this constituting the geosyncline known as the Tethys. Between the approaching continents the thick accumulations of sediment became compressed and folded, squeezed and metamorphosed, until by flowage and overthrusting they splayed out over the advancing blocks and rose in thickened contortions between them as the great Alpine-Himalayan mountain system. The New Zealand and New Guinea mountains are also interpreted as results of equatorial drift, the former having been folded while New Zealand was in " the prow of the movement," before it became detached from Australia and was left behind.

The most spectacular example of westerly drift is presented by the Americas with their great Cordilleran ranges facing the Pacific from Alaska to Patagonia. The mountains are regarded as the crumpled front edge of the sial. Lag effects on the eastern margins of the continents are seen in the island festoons of Asia and in the arcs of the Antilles between North and South America, and of the southern Antilles between South America and Antarctica.

It will be gathered that Wegener completely ignores the contraction hypotheses of mountain building ; he asserts, in fact, that we have no proof that the earth is contracting. He also rejects the hypothesis according to which the Atlantic and Indian oceans are interpreted as occupying basins produced by the inbreaking of former continental areas, due to greater radial contraction than that suffered by adjacent columns of the crust. Like the similar doctrine of submerged land-bridges this hypothesis appears to be fatally at variance with the implications of both isostasy and seismology. Wegener does not deny that the regions in question were formerly land. What he denies is that the land can have gone down into the depths, and since it is no longer there he adopts the alternative conclusion that part of the land has glided away sideways relatively to the other part, leaving a region where the sial is thin, patchy, or perhaps altogether absent. In reconstructing former hypothetical contacts, allowance must be made, of course, for the fact that continuity of sial with sial does not necessarily mean continuous land. The lower levels of the sial platforms have always been more or less flooded by oceanic waters, as they are to-day in the Baltic and North Sea, and consequently there is no need to visualize Laurasia and Gondwanaland as having been permanently free from epicontinental seas.

The Opposing Lands of the Atlantic.—Most of Wegener's critics are concerned to discredit the significance of the original source of his inspiration—the apparent parallelism of the opposite shores of the Atlantic. Van der Gracht rightly lays little stress on the validity of geographical pattern as an argument. If drift has occurred at all it is mechanically impossible that the sial blocks could have moved without both internal and peripheral distortion. Nevertheless, if the Atlantic is really an enormously widened rift, then the remains of transverse structures that existed before the rifting and drifting began, should still occupy positions consistent with their presumed former continuity, though not, perhaps, as Wegener suggests, as closely " as the lines of a torn drawing would correspond if the pieces were placed in juxtaposition." Argand's conception of varying plasticity in the earth's surface layers is a valuable

corrective to the exactly fitting coast-lines of Wegener's too dogmatic maps. Matching is to be anticipated, but that it will be as precise as has been claimed is not to be expected.

Schuchert presents a useful summary of the geological similarities and differences between the opposing Atlantic lands. He admits that Wegener is correct in connecting the Caledonian trends of Britain with those of Newfoundland (Fig. 2) but he denies that the Hercynian trends of Europe connect with the Appalachians. Against this view we may refer to Bailey's tectonic maps of

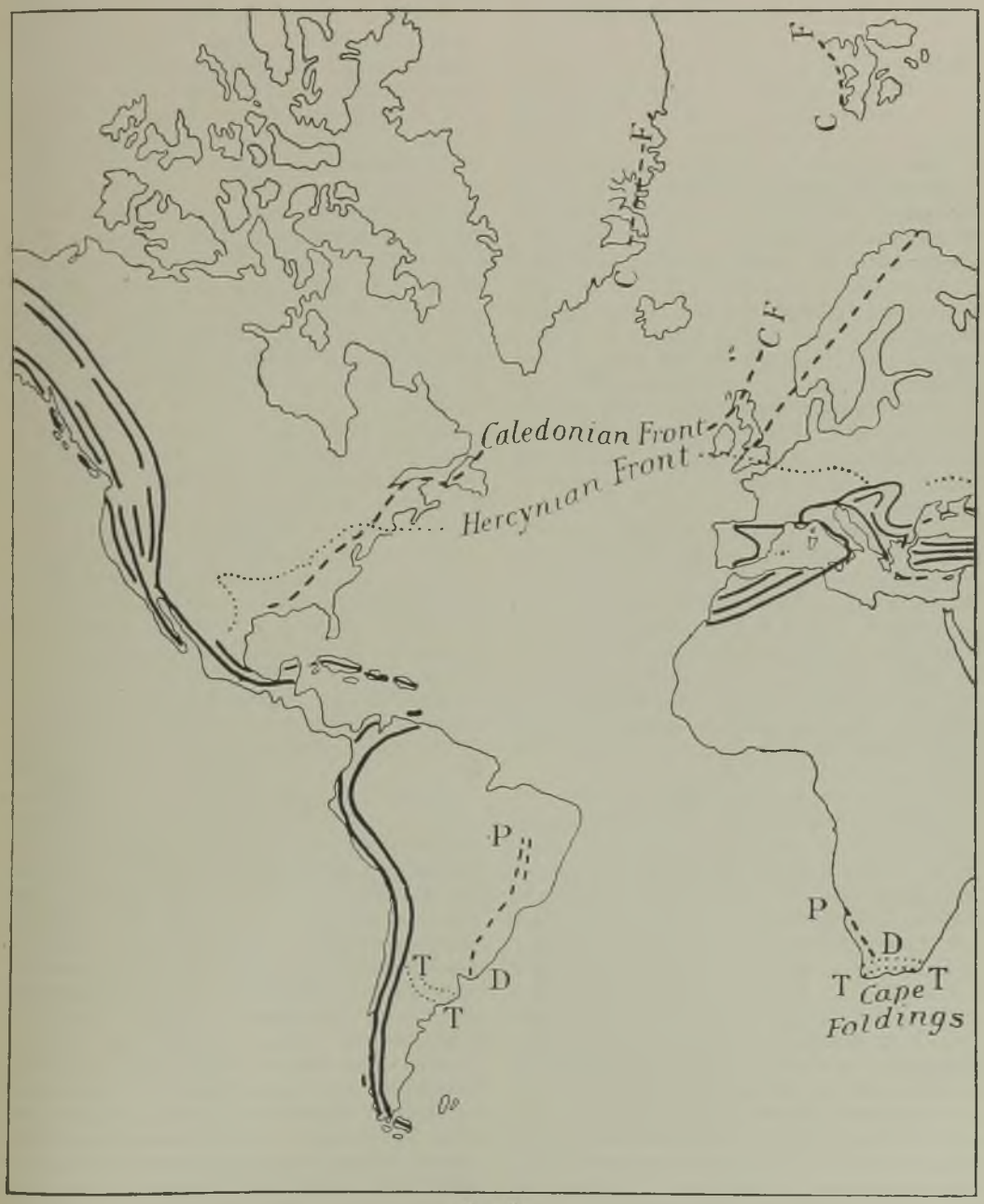

Fig. 2.

Europe and America, and his explanatory statement of the comparison (**4**). "For the last time let us take boat across the Atlantic, there to visit the American representative of the Hercynian System. We know exactly where to go. From New York southwards, the north-west front of the Appalachian complex consists of folded and often overthrust Palæozoic sediments that extend upwards into Coal Measures." The latter, he tells us, were "derived from the waste of the growing Hercynian Mountains, and we follow Bertrand in our thoughts to South Wales, the Ruhr and Upper Silesia." A most remarkable feature—recognized by Wegener and emphasized by Bailey—is the westward convergence of the Hercynian and Caledonian chains. On the east they are far apart in Poland and Lapland respectively. They come into contact in South Wales and Ireland, but the greater part of Ireland still lies between the two fronts. Across the Atlantic the geology of the Atlantic States "is summarized in the words *Where mountains cross*," and finally, "the Hercynian Mountain front steps clear of its Caledonian predecessor." The crossing begun in South Wales is completed in Pennsylvania.

It is equally startling to find that the overthrust Caledonian front has been discovered along the east coast of Greenland precisely where one would look for it if Greenland had formerly linked up the North-west Highlands with Spitzbergen. As shown on Fig. 2, the north-west margin of the Caledonian chain is missing from Norway. Was it torn away when Greenland broke loose and began its hypothetical drift to the west?

Turning now to the South Atlantic with du Toit as our guide,[1] we find a similar set of tectonic coincidences. Pre-Devonian folds known as the *Brazilides* trend from Minas (Brazil) to Maldonada (Uruguay). Across the Atlantic are the post-Nama foldings extending from Lüderitz to Caledon (PD in Fig. 2). Not only is there a general lithological resemblance between the two belts of folded strata, but in each area the latter are invaded by similar granites and succeeded by similar successions of Devonian and Gondwana formations, including late Carboniferous tillites. In both the Cape and the Argentine, mountain-building set in again about the beginning of the Triassic. The *Gondwanides* of South America are crumpled and overthrust to the north; so are the corresponding Cape foldings of South Africa (TT in Fig. 2). Just as in the northern hemisphere a crossing begun on the European side is completed on the American side, so here the foreshadowed crossing beyond the estuary of the La Plata is accomplished behind Cape Town.

Reference should be made to du Toit's book for a presentation of a most remarkable series of parallels (stratigraphical, palæontological, tectonic, magmatic, and climatic) in the geological history of the opposing lands of the South Atlantic, the whole assemblage of data pointing persuasively—unless Nature be a misleading witness—to the probability of a formerly closer union. An attempt has been made by Schuchert both in the Symposium (**1**) and in a review (**5**) of du Toit's book to explain the resemblances in terms of orthodox geology; to deny that they have the far-reaching significance that is claimed for them; and so to deal "a crushing blow" to the drift hypothesis. This adverse criticism du Toit has no difficulty in answering effectively (**6**). It is worth noting, however, that these doughty antagonists differ less than might be imagined. Avowed iconoclast as he is towards the Wegener hypothesis, Schuchert feels "obliged to conclude that the continents do actually move extensively" in order to explain the crustal shortening implied by mountain structures, and he quotes the impressive statement of Termier that the mountains of Central Asia represent a crustal foreshortening whereby 3,600 miles have been reduced to 1,845 miles. Van der Gracht naturally points out that if lateral movements of the order of 1,800 miles be admitted, then continental drift even on the scale visualized by Wegener becomes fully possible. On the other hand du Toit quite reasonably differs from Wegener by ruling out actual contiguity of the present continental borders as unwarranted. He is content to assume that the distance between the opposed shore lines was never less than 250–500 miles, the intervening space being then, of course, continental, with or without temporary invasions of shallow seas.

This departure from the closely fitting shores of Wegener is justified by the geological evidence, and is essential from the point of view of isostasy. Seismological evidence makes it clear that the Atlantic floor differs from that of the inner Pacific in having a thin and patchy covering of sial. Indeed,

[1] See map, page 247.

the S-shaped central swell of the Atlantic transmits surface seismic waves at almost the same velocity as a belt of sial of continental thickness would do. Now this is just the surface structure that would be expected to result from the stretching that would necessarily accompany the drifting apart of two continental areas. Between the separating slabs of sial there would be a belt that would become increasingly thinner, by flowage in the lower levels, and by fracture and faulting in the brittle upper levels (**7**). Molengraaff and Taylor (**1**) both regard the mid-Atlantic swell as the cicatrix of the main fractures that led to separation, and van der Gracht is inclined to agree. If now we imagine the continental slabs to be closed up again, it will readily be realized that the swell and the thinned-out sial of the adjoining ocean floor would be crowded together into a broad belt of continental thickness forming a land mass that would intervene between the present coast lines and prevent their contact by some hundreds of miles.

Similarities Between Mineral Provinces.—In du Toit's Presidential Address (**3**) he views South America no longer as a remote continent, but as a close relation which may be expected to have mineral deposits akin to those of South Africa. Expectation is fulfilled on a spectacular scale in the case of the diamondiferous deposits. Occurrences of late Cretaceous kimberlite and alnöite have been found in Rio de Janeiro and Minas, and the famous deposits of the Diamantina area are now known to be eruptive breccias filling gigantic pipes or fissures like those of the Saltpetre Kop type in the Cape. Further north the diamondiferous area of the Guianas is mirrored across the ocean by those of Liberia and the Gold Coast. Here too there are gold deposits on each side and it is further noteworthy that the belt of Silurian and Devonian rocks of the Lower Amazon Syncline appears to be continued through the Gold Coast into the Sahara. These and many other striking relationships go far to support du Toit's contention that "it is surely more than mere coincidence that the world's diamondiferous deposits, situated near to or upon the coast, should be all but confined to the regions lapped by the South Atlantic."

Du Toit next compares the manganese occurrences of Brazil with those of Griqualand West, and he shows that even so academic a problem as that of continental drift may have practical bearings in the field of mining. Minerals found in a particular geological setting on one side of the Atlantic may not unreasonably be looked for in similar settings on the other side.

It is worthy of notice in this connection that it has recently been shown by Arthur Bray (**8**) that the source of the Gold Coast banket lay to the south-east, and that the deposits themselves represent either a river-delta or a littoral shingle-beach. Thus where the Atlantic now lies there must formerly have been a great river, possibly transporting gold from a continent that has since either subsided far beneath the waves, or drifted away to the west where, perhaps, part of it is still to be recognized in the auriferous tracts of the Guianas and Brazil.

(To be continued.)

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(**2**) A. L. du Toit. "A Geological Comparison of South America with South Africa." Carnegie Inst., Washington, *Pub.* No. 381, 1927, pp. 157.

(**3**) A. L. du Toit. "Some Reflections upon a Geological Comparison of South Africa with South America." *Proc. Geol. Soc. S. Africa*, 1928, pp. xix–xxxviii, abstracts from which appear elsewhere in this issue.

(**4**) E. B. Bailey. "The Palæozoic Mountain Systems of Europe and America." Presidential Address to Section C, Brit. Assoc., Glasgow, 1928. *Nature*, November 24, 1928, p. 811. Report of the Brit. Assoc. for 1928, p. 57 (1929).

(**5**) C. Schuchert. "The Continental Displacement Hypothesis as viewed by du Toit." *Am. Journ. Science*, Sept., 1928, p. 266.

(**6**) "Reply by A. L. du Toit, to the above (**5**)." *Am. Journ. Science*, Feb., 1929, p. 179; and brief rejoinder by C. Schuchert, ibid., p. 183, referring to a paper that has since been published (see 26 below).

(**7**) A. Holmes. "Some Problems of Physical Geology," *Geol. Mag.*, June, 1927, p. 268 *et seq.*

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COMMERCIAL ASBESTOS IN THE UNION OF SOUTH AFRICA

By TUDOR G. TREVOR, A.R.S.M.,

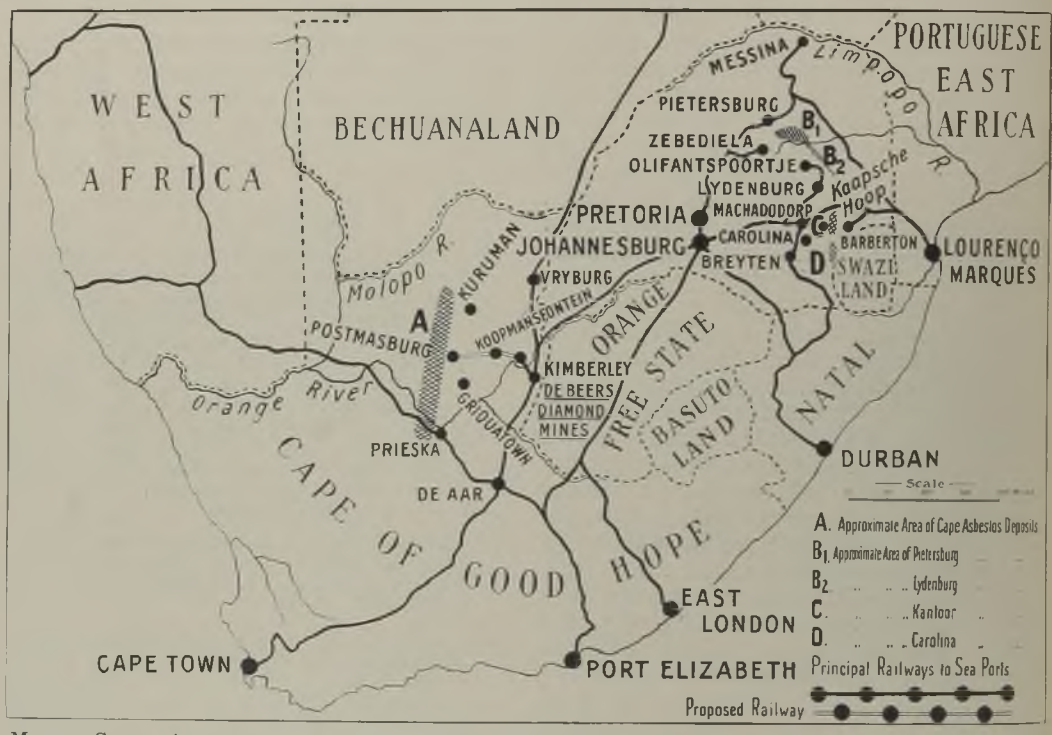
Late Secretary of Mines and Works, Northern Rhodesia, sometime Inspector of Mines, Transvaal.

The output of commercial asbestos from the Union of South Africa has been steadily rising for many years past. In the year 1911, the first year of Union, it was valued at £20,839, by 1920 the value had risen to £114,195, by 1926 to £216,466, and for 1927 the value was £343,301. The returns for 1928 are not yet published, but for the ten months up to October the figures total £327,334, so the output is still increasing at an encouraging rate, and the Union production bids fair in a few years' time to rival that of Southern Rhodesia.

Three distinct varieties of the mineral are now being produced, the relative output and values for the first ten months of 1928 being as follows :—

	Tons.	Value £	Per ton. £
Chrysotile	9,731	173,359 or say	17·8
Crocidolite	4,379	98,450 ,,	22·5
Amosite	5,454	55,525 ,,	10·2

Of the foregoing varieties chrysotile is the white silky variety so largely produced by Canada and Southern Rhodesia : crocidolite is the blue Cape asbestos, and amosite is a coarse yellow variety but of particularly long fibre which is, so far, only found in the Transvaal.



MAP OF SOUTH AFRICA, SHOWING POSITION OF ASBESTOS FIELDS IN RELATION TO PRINCIPAL RAILWAYS AND PORTS.

Chrysotile was first discovered in the escarpment of the Drakensberg in the Carolina district of the Transvaal some 25 miles east of Carolina Town and railway station. The occurrence consists of a series of parallel veins of cross-fibre chrysotile, occupying a position in a bed of serpentinous dolomite overlying a thick igneous sill, and outcropping for a distance of several miles along the upper escarpment of the mountain. The escarpment here makes what might be described as a clean-cut table edge with deep short "kloofs," or "corries," cutting into it, and indenting it to the depth

of half a mile or so. It is noticeable that the asbestos is better developed at the resulting outstanding points of the escarpment, than in the re-entering angles formed by these kloofs. The asbestos produced was of extremely good quality, and near the surface lengths up to four inches were not uncommon. The whole formation dips into the mountains at an angle of about seven degrees, and there is, in the writer's mind, no doubt but that both the total quantity of asbestos in the sections mined, and the length of fibre obtained, decreased as the depth from the surface increased. The mines have been worked intermittently since about 1905 and the deepest workings from the outcrop down the dip extended some 300 feet. In the neighbourhood of the surface the operations appeared to be profitable, but in every case there was a gradual increase in expense and a falling off in output as the depth increased. In other parts of the country where similar conditions occur, that is to say where the dolomite has become serpentinous through igneous intrusions, similar veins of chrysotile have been reported, but, so far as is known to the writer, none of these have yet been worked.

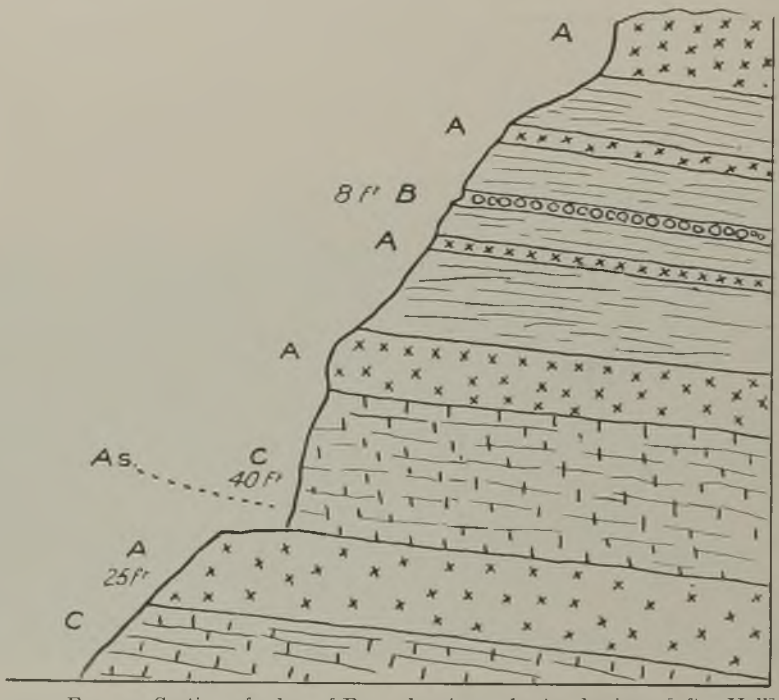
Type of Country in Drakensberg Fields.

Some forty miles to the north of the Carolina deposits, also in the escarpment of the Drakensberg, in exactly similar topographical, though in entirely dissimilar geological, surroundings, lie the main chrysotile deposits of the Union. These are owned by the Amianthus Company and the Munnik Myburgh Company and have been worked successfully for the past nine years. The mines lie just under the lip of the escarpment of the Kantoor Mountain about two miles from the village of Kaapsche Hoop. The top of the mountain here, as at Carolina, consists of dolomite and Black Reef quartzite, but coming up from the east is a ridge of ancient schists of the Jamestown series which passes unconformably under it. In these schists is an outcrop of serpentine some two miles in width and in this the chrysotile veins have been developed. There are two chrysotile horizons known as the "Griffin" and the "Ribbon" lines. The actual outcrop of asbestos has been traced for more than three miles, but since the serpentine goes on for many miles, certainly over twenty, it is not improbable that extensions will be found. The seams of chrysotile are spread over a thickness of some twelve feet and dip conformably with the strata at an angle of about ten degrees. The seams are crowded together and, according to A. L. Hall, up to thirty parallel seams may

be counted in a section of one foot, and in some cases the stoped rock may yield 40% of fibre. The yield for the mine when the writer last visited the property was said to be 5% fibre, of which 73% were grades between $\frac{1}{8}$ inch and $\frac{3}{4}$ of an inch in length, 10% being longer than $\frac{3}{4}$, and 17% shorter than $\frac{1}{8}$. Neither on the Amianthus mines, nor on the adjoining ground has any tendency been observed for the quality or quantity of the fibre to diminish with depth as is such a marked feature at Carolina.

So far as can be seen there are no reasons to suspect a short life to these mines, and extensions to the east are probable. To the west also, where the serpentines emerge again in the valley of the Elands River, new discoveries are possible. In all the ancient schists of the Jamestown series, which occur in many places, both in the Eastern Transvaal and in Natal, serpentine is a common occurrence and asbestos has frequently been reported ; it is by no means unlikely therefore that future discoveries of chrysotile mines may be made. In fact such a discovery is reported from the farm Kaalkloof in the district of Carolina, and is favourably noted in the last report of the Inspector of Mines for that district.

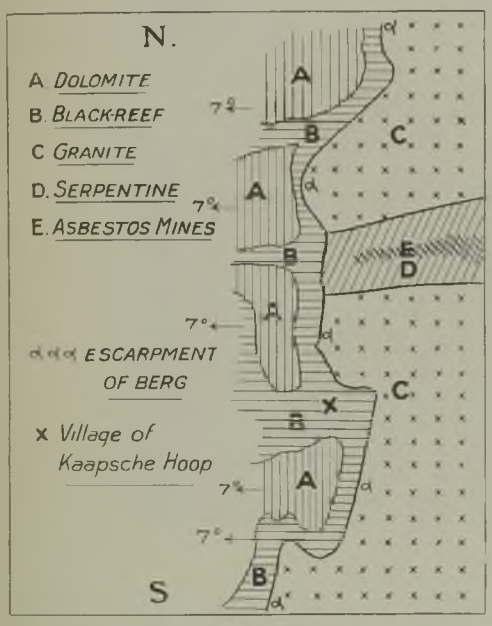
Crocidolite or "Cape Blue" asbestos has been worked in the north of the Cape Colony since 1893. The deposits occur in the Lower Griqua Town series—corresponding to the Pretoria series in the Transvaal—which is a series of hard ferruginous shales making ridges of high ground or hills which stretch from some twenty miles south of the Orange River near Prieska for a distance of no less than 200 miles north to the Mashowing River at Tsenin, north of Kuruman. In the southern portion this ridge is repeated three times by faulting or folding. The most westerly line is some 45 miles in length, the middle 75 miles and the eastern 200 miles. The asbestos-bearing rocks have therefore an effective outcrop of some 320 miles. The actual thickness of the asbestos-bearing rocks is estimated by Hall [1] at 2,500 feet, but as the dip is extremely variable, the width of the outcrop varies greatly from point to point with a minimum of five and a maximum of thirty-five miles. The asbestos occurs in interbedded veins which run in groups more or less anywhere within the thickness



Carolina Asbestos Field.—Section of edge of Berg showing asbestos horizon [after Hall]. *A*. Igneous sills. *B*. Quartzite and conglomerate. *C*. Dolomite. *As*. Asbestos horizon.

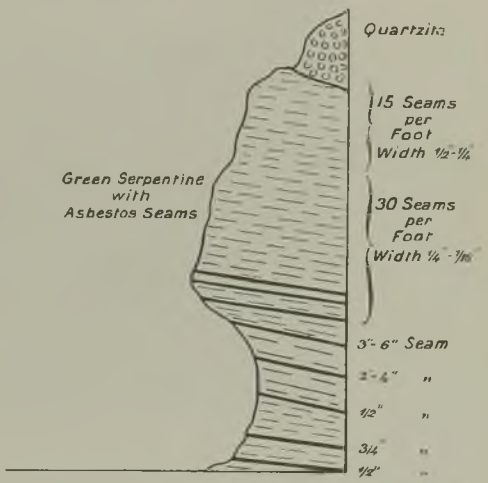
[1] Asbestos in the Union of South Africa, A. L. Hall. Memoir No. 12 of the Geological Survey of S. Africa. Pretoria, 1918.

of the series. A group or "reef" may consist of any number of veins, usually from three to seven spread out over a thickness of a foot or two. No one seam persists for many feet, but the group or "reef" may continue for several hundred yards and may then break off and appear again on a slightly higher or lower level. Under these circumstances systematic mining is impossible. There is no trouble with water in the mines which are all "bone" dry, nor does ventilation worry the labourers, and most of



GEOLOGICAL SKETCH MAP OF ASBESTOS FIELD, KAAPSCHE HOOP.

the mining up to date has been quite unorganized. Except for the general managers, there are few men of European birth or mining experience on the fields. As a rule an Afrikander of local extraction is in charge of a property and he gives out sections to half-caste Bechuana-Koranna native workers on a form of tribute, or piece work. These natives grub out the mineral in any way they please, cobbing it and receiving so much per sack for the cobbed material, which is taken to headquarters to be dressed and sorted. In a few cases the owners have put in long adits on the "reef," in which case blocks for stoping are given out to the coloured tributors. The results of these methods of mining look more like magnified rabbit warrens than mines, but taking all the circumstances of the case into consideration, and given the peculiar class of native labour available, the financial results are probably more profitable than could be obtained by any attempt at systematic mining. Over the whole area the climate is arid and practically desert, and the question of finding water for the necessities of organized mining, would, in itself, in the case of most of the deposits, put such mining out of the question. As it is, the labourers are satisfied with what water they can find for themselves, usually probably not more than a pint or so per man per day, and live as they love to do in temporary shelters and "pondockies" which would be impossible in another climate or to any other people.



AMIANTHUS MINE.—Section of face [after Hall].

The deepest workings of which the writer has heard are not more than 250 ft. below the surface, but some of the adits are over 1,000 ft. in length. There is a belief that the fibre gets shorter in depth, but that the actual quantity in a section is not affected by this cause.

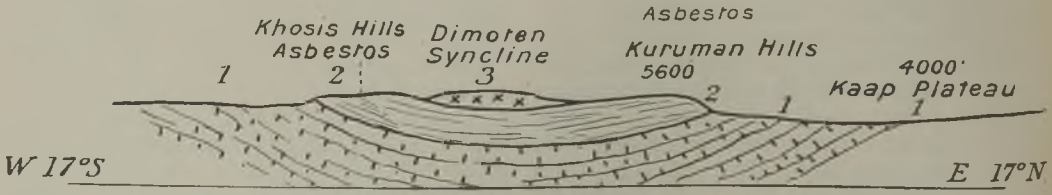
With regard to the future of the field all that one can say is that probably not one-twentieth of the known occurrences have been opened up, and that the fields are of such great extent and so sparsely inhabited that there must be many more deposits to be found than have yet been recorded. Under these circumstances there is no reason to set any limitation to the life of the fields as at present worked. On the other hand, as to increasing the output by more intensive work great difficulty is foreseen, for the quantity of Bechuana-Koranna labour is strictly limited, and no other workmen could be

employed economically on the present system.

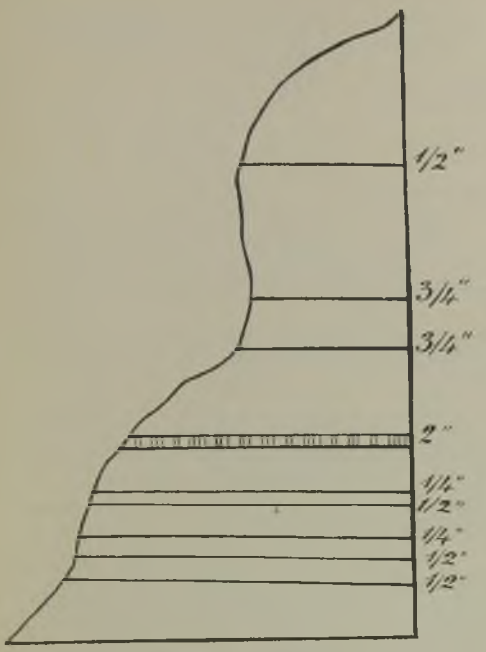
Crocidolite also occurs in the Transvaal in the southern portion of the Pietersburg district. The rocks here—the Lower Pretoria series—are geologically the same as those called the Lower Griquatown series, which carry the mineral in the Cape Colony. The asbestos-bearing rocks are, in hand specimens, identical with those of the Cape, though on the whole those of the Pietersburg district are harder and more indurated. The physical features of the country and the climate, however, are entirely different. In the Colony the country is an arid desert of low relief in which the "asbestos mountains"—though they are in reality only low hills—make a marked feature. In the Pietersburg district the climate is humid and the country extremely mountainous, consisting of knife-edge ridges separated by narrow impassable gullies. The whole of the ferruginous shales over a section some two miles in width carry seams of asbestos, either crocidolite or amosite for a distance along the strike of some twenty miles from M'Pathelell's River to where the formation crosses the Olifants River into the Lydenburg District. It is curious that while the two varieties are associated north of the Olifants River, south of the river only amosite occurs. The general mode of occurrence is similar to that in the Cape Colony, but owing to the deep erosion of the valleys and gullies much greater advantage may be taken of adit working, and there seems to be more chance of carrying out mining on an organized plan, the only disadvantage being the excessive hardness of the rock, which, in some places, may render hand-drilling impracticable. Though considerable quantities of crocidolite may be won from this area, the writer is inclined to think that the main production will be of amosite.

Type of Country in Cape Asbestos Fields.

Amosite.—As remarked above the asbestos-bearing line of the South Pietersburg district crosses the Olifants River into the district of Lydenburg, but whereas in the former



Cape Asbestos Field.—Section across Kuruman Hills [after Rogers]. 1. Lower Campbell Rand Series (Dolomites). 2. Lower Griquatown beds (with crocidolite). 3. Middle Griquatown beds.

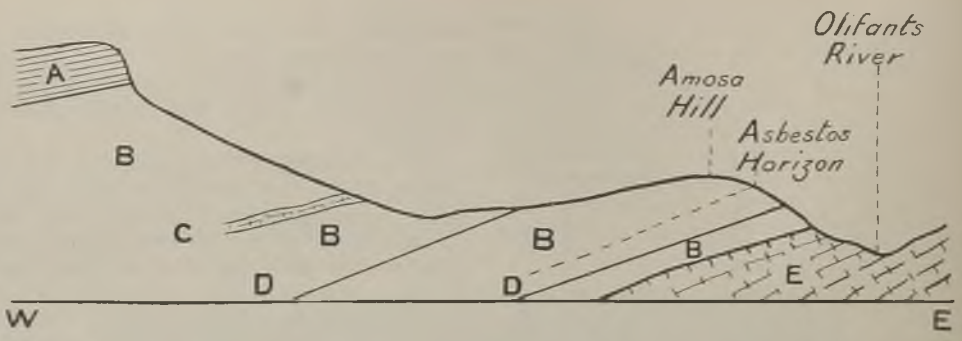


Cape Asbestos Fields.—Section showing 6 in. fibre in nine seams over 8 ft. [after Hall].

district both the amosite and crocidolite varieties are present, in the latter amosite is enormously developed while crocidolite is absent. This development reaches a magnitude quite unknown in any other asbestos field, for in some portions of the line, for more than two miles on the farms Streatham and Penge, the seams of amosite run with such regularity and persistence that they have been developed as regularly as a banket mine might be, and regular stope plans and value plans are possible.

The principal asbestos horizon lies some 200 ft. above the base of the shales and the fibre is not scattered through the whole formation as is usually the case elsewhere. Much of the fibre is over six inches in length and a very large proportion over three inches. Two mines, the "Egnip" and "Amosa," have developed the beds down to 350 ft., and no deterioration of the fibre, either in quality or quantity, has been noted. A section 21 ft. across, gives a combined width of fibre of 30 inches in nine seams running from three-quarters of an inch up to seven inches in width, and similar sections are by no means rare. Some years ago the manager of the "Amosa" mine estimated that down to the 300 ft. level on that mine over 100,000 tons of fibre were in sight. The chief difficulty in this area arises from the mountainous nature of the locality, which might almost be described as lying at the bottom of a canon—to which access is impossible without great expense in road-making; otherwise, labour is cheap and plentiful, the climate reasonably good, and there are no mining difficulties. For the amosite variety of asbestos there has not, however, been a good market in the past, for reasons given below; otherwise the development would have been very much greater.

Type of Country in Pietersburg Asbestos Field.



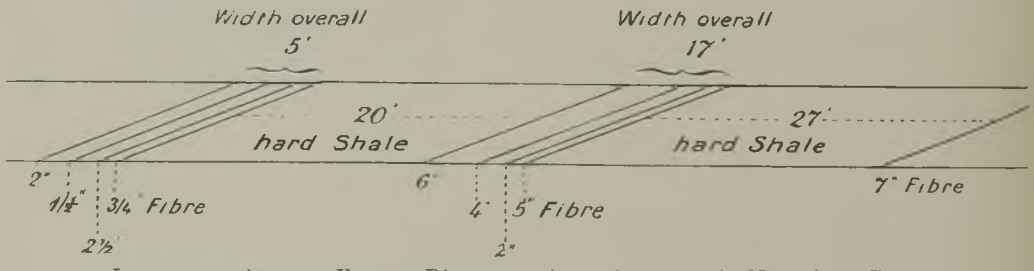
Lydenburg Asbestos Field.—Section showing amosite horizon on Penge [after Hall]. *A*. Time-ball hill quartzites. *B*. Ferruginous shale. *C*. Bevit's Conglomerate. *D*. Igneous sills. *E*. Dolomite. Length of section 1⅛ mile.

To sum up the position and prospects of the asbestos mining industry in the Union of South Africa, the following generalizations may, in the writer's opinion, be accepted :—

Chrysotile.—The output from the present mines will probably be maintained and even increasing for some years to come. There is also a strong probability that new mines will be discovered, and it should therefore cause no surprise if the output becomes doubled in the next few years.

Crocidolite.—The present output may be continued for many years, even indefinitely, but it is doubtful, owing to labour and climatic difficulties, if the output from the Cape can be very much increased. From the Pietersburg district of the Transvaal a very considerable increase may occur.

Amosite.—With a keen market for this material, and the demand increasing, the output could be doubled in a very short time, and maintained for years, but it is not likely to displace the other varieties, as by reason of its coarse texture its use is confined to the manufacture of the rougher varieties of products.



Lydenburg Amosite Field.—Diagrammatic section on main No. 1 level Penge.

Institute of Metals.—The 21st Annual General Meeting of the Institute of Metals was held in London on March 13 and 14, at which it was appropriate that announcement could be made that membership had now passed the 2,000 mark. The following papers were presented :—Special Properties of Eutectics and Eutectoid Alloys in Binary Metallic Systems, by P. Saldau, of the University of Leningrad. Work-Softening and a Theory of Intercrystalline Cohesion, by F. Hargreaves and R. J. Hills. The Constitution of Cadmium-Rich Alloys of the System Cadmium-Gold, by P. J. Durrant. The Age Hardening of some Aluminium Alloys, by Marie L. V. Gayler and G. D. Preston. Brittleness in Arsenical Copper—II, by C. Blazey. The System Magnesium-Zinc, by W. Hume-Rothery and E. O. Rounsfell. An Improved Electric Resistance Furnace, by W. Rosenhain and W. E. Prytherch. Recent Developments in Electric Furnaces, by D. F. Campbell. Alloys of Zirconium—II, by C. Sykes. Resistance of Lead to Indentation, by J. Newton Friend and by the same author The Solution of Plain and Amalgamated Zincs in Electric Batteries and the Silver Contents of Ancient and Mediaeval Lead.

LIGHT STEEEL SETS AS MINE ROADWAY SUPPORTS

By R. E. RICKARD, Assoc.Inst.M.M.

The use of steel or iron sets for the support of levels, galleries, etc., has been the subject of numerous papers, and mining text-books usually devote space to their application and limitations.

In most instances, their use has been confined to the support of main haulage roads, where strata have settled, where the pressure is uniform and liable to remain constant. In the majority of cases the sets consist of steel H-girders or heavy steel rails. The obvious advantages of these metallic supports in permanent roads can be readily appreciated, but, hitherto, their adoption has generally been found unsuitable in temporary or less permanent workings subject to varied and irregular pressure. Under the latter conditions, the first cost, the rapid deflection and rupture of the steel, and mainly the difficulty and cost of replacing or "re-timbering," has, in most cases, resulted in the abandonment of their use.

Within recent years, a new departure in metallic supports for galleries has been developed in the coal mines in the Loire Basin and elsewhere in France. After obtaining very satisfactory results with this class of support, the writer believes its adoption might be successfully extended to certain metal mines, where close timbering of levels is necessary, as in soft-ore mines, particularly in countries where good timber is scarce and costly.

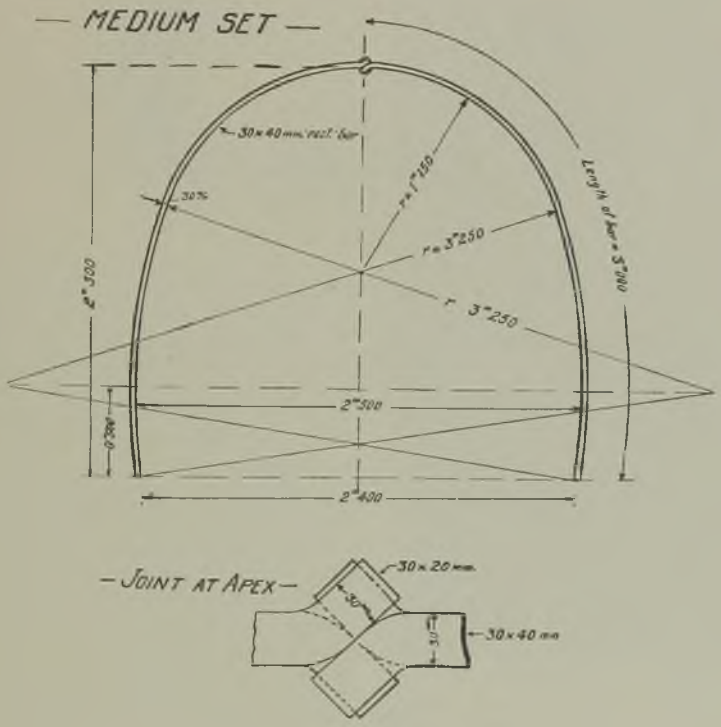


FIG. 1.

Each set consists of two mild steel bars (rectangular cross section 30 mm. by 40 mm.), bent so as to form an arch of uniform shape (Figs. 1 and 2). A simple butt-joint is used to connect the two bars at the apex. This simple joint can be made by any mine blacksmith, and the bars are bent cold with

a bending machine. Special installations for the manufacture of these light sets have been made at French mines, where great numbers of them are employed.

This supple metallic set is characterized by its flexibility, and in this respect differs mainly from the usual steel or iron set, where

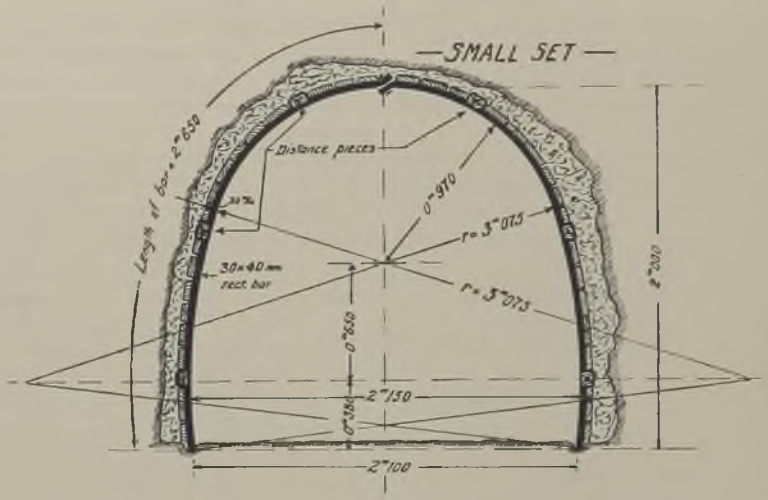


FIG. 2.

permanent rigidity is aimed at. This flexibility allows it, on the one hand, to deflect more or less evenly without breaking, according to the pressure to which the gallery or level is submitted, and on the other hand, to be easily withdrawn and re-shaped to its original form, once the maximum limit of deformation has been reached or the life or usefulness of the gallery or level has been terminated.

These mild steel sets can be employed, within certain limits, to replace timber in the support of galleries, levels and inclines of small cross-section, in bed mining, drift mining, soft-ore mines, or in mines where the workings are subject to moderate or great pressure or " crush." They are particularly suited to temporary or semi-permanent roads, which, in the course of mining operations and stoping, are due to disappear. At such a time the sets are withdrawn, re-shaped, and used over again.

They offer the following advantages over timber under similar conditions :—(1) *Lightness.*—A medium set weighs 55 kgs. as compared to 65–110 kgs. for a pine or fir set, 15–20 cms. in diameter and giving the same all-clear height and width. Transport is easily effected. One man carries half a set with ease. (2) *Simplicity of construction.*—The sets can be made by any mine blacksmith from straight-bar (mild) steel. (3) *Strength.*—Owing to their arched shape, the sets resist pressure better than timber, on condition that they are well stowed behind the lagging. The stowing is an important factor. Fines only should be used in filling the voids behind the lagging. (4) *Speed of setting.*—With experienced labour, these sets are more quickly placed than timber. Moreover, they require less excavation for a given height and breadth. Miners and timbermen rapidly become proficient in the work. (5) *Elimination of waste.*—In timbering, under most conditions, it is unavoidable to eliminate a certain amount of waste of timber, ends being sawn off, joints cut, etc. (6) *Reduction in gallery or level maintenance.*—Since their introduction, a great reduction in maintenance costs has been experienced by mines employing this method of support. (7) *Indestructibility.*—As has already been pointed out these sets can easily be withdrawn, re-shaped and used over again. They can almost be considered indestructible and it is in this respect that they effect a great economy in certain classes of mines.

Generally speaking, workings protected by this method of support, with the complete revetment of planks, are cleaner and freer from rubbish and crumbling mineral or rock than are timbered workings. In a mine, with which the writer is connected, a considerable quantity of broken timber is recovered from old workings and crushed zones. The lagging or casing of the steel sets has, up-to-date, been made exclusively from this broken

timber, sawn up in convenient lengths and thicknesses. Even barrel staves have been used with success.

Method of setting up.—The required excavation having been made, shallow notches or " hitches " are cut in the floor to fit the legs of the sets. A pair of sets are

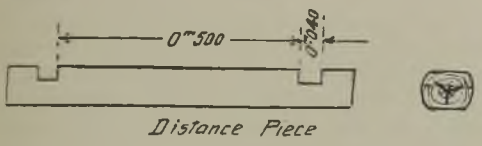


Fig. 3.

placed a predetermined distance apart and held in position by six wood distance-pieces (Fig. 3). In practice it is found advisable to set the legs slightly closer than the design. This is important. The sets are spaced 20 cms. apart (in very heavy ground) to 80 cms. apart, 50 to 60 cms. being common. If the nature of the ground permits, a greater number of sets are placed at a time, but the usual practice is to complete one set as soon as the necessary excavation has been made. The lagging is then placed, commencing at the bottom, and the space behind the casing is completely filled or stowed with mineral, fines if possible. All voids must be avoided, especially where filling is the most difficult—at the apex. The ideal lagging consists of straight-edged plank, 2–3 cms. in thickness, cut to length according to the distance between the sets, and about 10 cms. in width. Under most mining conditions, small planks, such as are required in conjunction with these sets, can, in part, be produced from broken timber from crushed zones and from the waste at the saw-mill. For levels or galleries of greater cross-section, sets made with heavier bars are recommended. A combination of the smaller type with the medium type is used where a water ditch is maintained. In spots where a bad floor occurs, pieces of old rail or blocks of wood serve as sill-pieces. In " running " ground, with skilled labour, spiling or fore-poling can be carried out with perfect safety. To withdraw the sets, the " Sylvester " patent prop-drawer or " pull-jack " is used.

Royal Society of Arts.—Before the Royal Society of Arts on March 26 Mr. H. Warrington Smyth, the former Secretary of Mines and Industries in the Union of South Africa, read a paper on the base metal and mineral resources of the Union, including coal, oil-shale, copper, tin, chrome ore, and asbestos. The author's declared object was the instruction of those members of the British Association who will be visiting South Africa in the coming summer.

British Patent System.—That reform of the British patent system is urgently needed is made evident from figures recently disclosed in the House of Commons, showing that the rate at which applications are increasing is beyond the ability of the department to deal with. In February last the total number of arrears of complete specifications awaiting first examinations amounted to 8,400 and the rate of increase is 76 per week.

THE PRODUCTION OF SULPHUR FROM PYRITES BY SUBLIMATION OR VOLATIZATION

By ARTHUR J. CADDICK, M.Inst.M.M.

The production of sulphur from pyrites has been a subject of investigation over a long number of years, the different processes employed being, among others, the direct sublimation or volatization of the sulphur, the burning of the pyrites and the treatment of the resultant sulphurous gases for the recovery of their sulphur content, and the subjecting of heated pyrites to the action of hydrogen and the recovery of the sulphur from the resultant gases.

In the present communication it is proposed to review and record the methods which have been used and advocated to obtain the sulphur from pyrites by sublimation or volatization. These can be considered under two main headings :—

(1) To obtain the first atom of the sulphur of the pyrites, FeS_2, leaving pyrrhotite or other iron sulphides of the general composition $Fe_{(n)}S_{(n+1)}$.

(2) With the object of obtaining the whole of the sulphur content of the pyrites.

(1) Dealing with the first heading for the sublimation of the first atom of sulphur from the pyrites, in general the reaction may be taken as

$$7\ Fe\ S_2 = Fe_7\ S_8 + 3\ S_2.$$

The distillation by external heating has been practised the world over, and as far back as 1863 some 2,440 tons of sulphur were produced in Bohemia by distillation in earthenware tubes. The amount of sulphur recovered was about one-third of that contained in the pyrites treated.

The same process was conducted in China for some hundreds of years by distillation of pyrites in clay crucibles, less than one-half of the sulphur contained in the pyrites being recovered, and the purity of the product being 97% to 98%. At St. Gobain, France, distillation was conducted in a clay retort placed on the top shelf of an ordinary burner for pyrites smalls. Labin, the French investigator, uses a furnace heated with producer gas to sublime sulphur from minerals (French Patent 353,830), and Urbasch uses a vertical retort externally heated by producer gas for the distillation of pyrites or spent oxide, the oxygen-free products being conducted through the charge.

A shaft furnace is used by Pidersen for the extraction of sulphur from sulphide ores, by regulating the air supply at the bottom of the furnace in which pyrites or other sulphide ore is roasted along with a quantity of coke insufficient for the reduction of the ore to metal. The sulphur vapour is distilled off and can be suitably collected (English Patent 152,887).

As regards continuous processes Hall in his 1912 and 1913 English patents claims to obtain part of the sulphur by distillation by the application of a direct reducing flame, and in various United States patents a moving mass of pyrites, while being agitated, is heated in the substantial absence of materials capable of combining with it to a temperature at which the loosely combined sulphur atom is expelled. Fresh pyrites is continuously introduced into the heating chamber and the desulphurized ore withdrawn.

In a German process, the material containing sulphur is heated in the presence of a gas which is inert to sulphur to a temperature at which the molten sulphide decomposes with the separation of elemental sulphur, a low sulphur matte being left as residue (German patent 313,122).

Marchal, dealing with the decomposition of iron pyrites into ferrous sulphide and sulphur heats the pyrites in a vacuum or in an atmosphere of nitrogen, and states that decomposition commences at 500° C., is more rapid at 550°, and at 670° to 680° is complete in 8 hours. At 700° to 800° the sulphur condenses, at 850° the decomposition is complete in 2 hours, and at a higher temperature, 1,200° the residue contains small amounts of metallic iron. Decomposition is very rapid in an atmosphere of nitrogen at 850° C. (G. Marchal in Bull. Soc. Chim., 1924).

Further information as regards temperature necessary is given by Rigg, who states that when pyrites is heated at a temperature below its melting point, 600° to 800°, in the absence of air, a portion of its sulphur is expelled and magnetic sulphide (pyrrhotite) is formed (G. Rigg and New Jersey Zinc Co., U.S. Patent 1,103,081).

Also in the patents of Rigg and the New

Jersey Zinc Co., it is claimed that sulphur is obtained by heating pyrites with the exclusion of air to 600° to 800°, until it has passed over into pyrrhotite or magnetic sulphide (U.S. Patents 1,103,081–2).

In a German process an electric furnace is used, the pyrites being heated with silicon to a temperature of about 1,500° out of contact with air. Ferro-silicon is formed, part of the sulphur is distilled off, and part remains with copper as a matte (German Patent 310,526).

At Mount Lyell experiments were made in 1916 with a view to extracting part of the sulphur contained in sulphide ores before smelting, and the investigations resulted in an experimental sulphur-extraction plant being erected.

(2) Turning next to volatization with the object of obtaining the whole of the sulphur content of the pyrites, the investigations conducted are very much less than those made to obtain the first atom of sulphur only. Of the investigations conducted the following are the principal.

Wright in his process treats the pyrites in a tilting electric melting furnace having a single carbon electrode in the top and a metallic plate electrode in the bottom. The top is closed and the sulphur vapours are conducted through an opening in the top of the condenser. The charge is heated to 3,000° and it is said practically all of the sulphur will distil off, leaving a bath of molten iron (English Patent 164,049, 1915). From other investigations in an electric retort furnace it is stated that when pyrites is heated to a very high temperature most of the sulphur is set free, and is collected in the distillate (English Patent 26,128 of 1911).

In a Norwegian process pyrites is melted in an electric furnace, and it is stated one half of the sulphur is liberated and one half may be obtained by electrolysis (Patent 176,779, 1921, Norsk Hydro Elektrisk Kvallstofaktieselskab).

By an English process it is claimed to obtain practically all of the sulphur from pyrites by heating in a retort in a stream of carbon monoxide or nitrogen with the addition of small regulated amounts of oxygen, by which the iron is burned to Fe_2O_3 and the sulphur liberated (English Patent 10,295,[1] Frehling, Fleming, and Whitlock).

A Japanese investigator, Heihache Kamura, gives as the result of his investigations the heat of dissociation of pyrites, or rather the heat evolved in the combination, expressed thermochemically as follows :—FeS, S gas = 18,611.

[1] Year of this Patent not given.

LETTER TO THE EDITOR

An Unusual Slag Structure

The Editor :

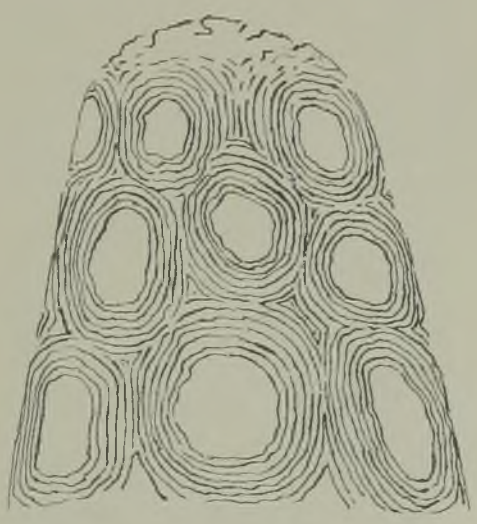
SIR,—I enclose a sketch and a photograph illustrating a peculiar structure in a lead blast furnace slag and wonder if any of your readers can explain the reason for the structure.

A partial analysis of the slag was :—

SiO_2	20·9%
FeO	36·0%
CaO	17·9%
Al_2O_3	12·6%
NaO	4·4%
ZnO	3·9%
Sn, Sb, Cu, Pb, Cl and O	Small percentages.

The structure is orbicular rather than pearlitic, each nucleus being surrounded by numerous very thin layers of slag ; the nuclei and the laminae being, apparently, of the same composition, and the structure persisting right through the mass.

After weathering for a few days the slag



crumbles to dust and cannot be directly re-used in the blast furnace without either pretreating or mixing with a greater quantity of other slag.

It is generally taken for granted when the soda content is more than between 3 and 4% there is a liability for this structure and the subsequent crumbling to occur.

Is it a case of incipient crystallization, and, if so, of what mineral?

Can the formation be avoided and a slag, able to be re-treated if necessary, obtained, with the same soda content?

J. B. RICHARDSON.

Highgate, London.
March 10.

BOOK REVIEWS

Diamond: A Descriptive Treatise. By J. R. SUTTON. Cloth, octavo, 115 pages, illustrated. London: Thomas Murby and Co. New York: D. Van Nostrand Co. Price 15s.

This work is exactly what it sets out to be. It is a most complete descriptive treatise of the mineral "diamond" by an author who has had access to the whole output of the De Beer's Mines for many years. It is obviously not the result of a few months' special study, but rather of the accumulated observations of years recorded with pen and pencil in an admirable manner.

In dealing with such a rare and valuable mineral as diamond most authors have to rely largely on the observations of others, which they themselves are unable to check, and in course of time a large number of fallacies get accepted as fact and pass current, not only verbally amongst the miners, diggers and dealers, but even in serious literature on the subject.

Dr. Sutton, from the beginning to the end of his work, relies almost entirely on his own experience and that of his colleagues in De Beer's, and challenges and exposes a great number of these fallacies. In fact, most of the "mysteries" of the diamond are so challenged and proved to be without foundation.

The author is wise in thus strictly limiting the scope of his work to the matters which

have come under his own observations :— These are the crystalography, morphology, and physical features down to the minutest detail, of the diamonds produced by the De Beer's group of mines. He mentions very little about stones found elsewhere, and out of twenty-seven chapters he only devotes one to theories about the genesis of the diamond, while on all matters concerning the geology and origin of the diamond-bearing pipes, and of the alluvial deposits, he is absolutely silent.

The chapter on the genesis of diamond is extremely interesting, for the author demonstrates from the facts which he has recorded that the commonly accepted theories are untenable. At the end of the chapter he summarises his own conclusions. There are five of these, but only the second and the third come sufficiently within the knowledge of the present reviewer to justify him in attempting the rôle of critic : these are :—

> "2. It (diamond) separated from the magma first as a plastic crystal becoming solid later on.
>
> "3. It grew by successive superimpositions mostly continuous, though sometimes intermittent, of plastic shells, either on the plastic, or on the solid, crystal core."

A plastic diamond crystal is difficult to visualize, but the idea, if feasible, would allow for the shape of macles and many other observed phenomena, while the third conclusion is the only possible one in the face of "hailstone" diamond and "overgrowths."

The final short chapter on "The Law of diamond values" is also original and interesting. The general impression is, and has been for the last thirty years, that there is no law of value for different sizes of stones of the same class, but that the price depends entirely on what the retailer of the cut stones may be induced to pay. The author, however, shows by a table of the prices actually obtained for Bultfontein stones in the market, that prices do conform, within quite close limits to a law and he expresses that law by the formula :—

$(N - 1) D + P = R$

R = Total value of the stone.
N = Weight of stone in carats.
P = Price of a stone of one carat.
D = The difference in price between a stone of one carat and a stone of two carats.

If therefore the empirical difference in market price between a stone of one carat and a stone of two carats is known the value of a stone of similar quality of any other weight can be fairly accurately estimated.

The book is excellently printed and illustrated, and may be strongly recommended as one containing a mass of accumulated reliable observations about diamond, well recorded, and with no more theory or assumption than is justified by those observations.

TUDOR G. TREVOR.

☞ 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.

NEWS LETTERS

JOHANNESBURG

February 7.

MANGANESE.—The Union Manganese Mines and Minerals (S.A.) Ltd., has sold its manganese and asbestos mining rights to the British Swiss International Corporation of London for 225,000 shares of £1 each in a company to be formed with a capital of £1,000,000. These properties consist of the freehold of nine farms, representing an area of approximately 54,000 acre, in addition to 20 mineral leases representing an area of approximately 89,000 acres, as well as the mineral rights over one farm. The total area covered by the freehold farms, mineral leases, and mineral rights is approximately 145,000 acres. Since its inception the Union Manganese Company has spent over £15,000 on prospecting and development work, and has recovered on surface 15,000 tons of high-grade ore ready for shipment.

Negotiations between the Minister of Railways and Harbours and the British Swiss International Corporation represented by Mr. F. N. Pickett (chairman) and Mr. L. Aldridge (managing director) have resulted in an agreement whereby the company will provide the capital required for the construction of a railway to the fields. The amount, which will bear interest at the rate of 4½% per annum, is to be refunded to the company at the end of ten years. The railway will be built, owned and operated by the Administration. The company will, in addition, deposit securities to the value of £100,000 in Government stock, or other securities to the

satisfaction of the Administration, to cover the guarantees and obligations undertaken. During the period of the agreement the company undertakes to pay to the Administration any loss in working the railway, including interest charges. A further undertaking is that during the first year after the line is open for public traffic the company will rail manganese ore to the extent of 200,000 tons, and thereafter in each of the remaining nine years to rail not less than 350,000 tons per annum. Any shortfall in tonnage is to be paid for by the company at 2s. per ton, and any payments so made to be included in the earnings of the railway. Provision has been made under certain circumstances for other manganese interests to use the railway for the transport of manganese ore.

A most important feature regarding the future economic possibilities of the Postmasburg fields is the question of the manufacture of ferro-manganese, either on the fields or elsewhere in South Africa. The Government is making arrangements to establish a steel industry in this country, and it is quite possible that the industry will produce its own ferro-manganese from Postmasburg ore. The agreement between the Government and the British Swiss International Corporation provides that in the event of satisfactory arrangements being made with the Electricity Supply Commission, the company will erect works in the Union for the purpose of treating manganese ore and its conversion into manganese products. The works will have a capacity to treat 50,000 tons to 100,000 tons per annum according to circumstances. It is probable that these works will be erected at Colenso, Natal, where there is a large generating station and a good water supply.

Transvaal Chromite Industry.—Government returns indicate that the Transvaal chromite industry is making steady progress. The value of the Transvaal's exports rose from £24,939 in 1927 to £35,265 in 1928. Contracts already entered into call for the shipment of approximately 50,000 tons of Transvaal chromite. The general quotations for Rhodesian and Transvaal chrome ores are respectively 90s. to 95s. per ton, 48% minimum, and 60s. per ton, 52% minimum, c.i.f. in each case. Expressed on the usual unit basis, Transvaal ore costs the European or American user 1s. 6d. per unit as against 2s. per unit for the Rhodesian material, both prices being c.i.f. at his nearest port. As usual the higher grade ore commands the better price. The future of Transvaal ore, therefore, depended upon the ability of the user to apply the cheaper unit to his process without modification of plant or method and without material increase in process cost. Trial shipments have proved, particularly, so far, to numerous German users that Transvaal ore requires no appreciable alterations in method, and that the over-all cost of using it is less than the corresponding cost of applying Rhodesian ore. Consequently these users have entered into contracts for their future requirements, running into considerable tonnages. Meanwhile a similar educational process is being carried out in the United States, and several big users there are approaching the point where they can, with confidence, make similar provision for the future. Those who are in intimate touch with the business prophesy that in five years' time exports of Transvaal chromite will reach 200,000 tons and possibly top the quarter-million mark in 1935. The Transvaal industry is favourably situated in several respects. The average mining width is considerably greater than in Rhodesia, ranging from three feet upwards towards the ideal width of five feet. In the Rustenburg district the mine trucks are drawn directly from the mine workings on to the storage platform commanding the railway siding, while in the Steelpoort area one good area now being worked is only three miles by road from the rail.

Rock Bursts Menace.—As mining on the Witwatersrand reaches greater depths some more efficient method of supporting the workings will have to be devised if the danger from rock bursts is to be minimized. Mr. Paul Selby, manager of the Ferriera Deep, introduced on that mine some 22 years ago the reef pack method of stope hanging support because the mine was then considered unsafe by the Mines Department and something had to be done to save it. This method of packing was adopted without sacrificing the tonnage sent to the mill, although the tonnage of reef packed was steadily increased up to a maximum of 187,114 tons in one year, and in the 17 years from the inception of reef packing on the Ferreira Deep mine in 1911, up to the present time, the surveyor's figures showed that 1,269,402 tons of reef were packed.

At the end of September, 1928, the tonnage remaining in packs was probably between

10,000 and 15,000 tons. These packs have since been recovered, and when the mine closes down, probably in March or April, it is safe to say that the packed tonnage which will not have been recovered will be less than 1,000 tons—in other words, less than one-tenth of 1% of the total which was packed, or in terms of gold lost in this way, the figure will be less than one penny per ounce of gold contained in the ore packed. But for the reef packing method of support, milling operations on the Ferreira Deep would have terminated several years ago. Mr. Selby claims that reef packing is the cheapest method of hanging support possible on the Rand, and will become of increasing importance as mining is carried to greater depths.

Transvaal Emerald Field.—It is reported that the Emeralds (South Africa) Company's prospecting operations during the last few weeks have disclosed indications of the existence of an emerald mine in extent 600 feet by 50 feet on the company's property. Crystals of good quality are said to have been found over the whole of the area mentioned Recently the prospector who discovered this beryl-emerald field found crystals on the side of a hill on the Beryl Mining-Emeralds (S.A.) line of strike about six miles nearer Gravelotte, and pegged claims there. There are indications that Rand mining houses and London firms are inclined to take a hand in opening up these interesting discoveries, and in at least one instance an offer of financial assistance has been made. It is probable that English experts will be asked to report on the field.

Radio-active Ore in S.W. Africa.—A syndicate is being formed in Capetown to exploit an occurrence of radioactive ore in South West Africa. It is stated that some years ago a prospector who was searching for diamonds in the territory came across an interesting occurrence, specimens of which he submitted to Professor Hahn, a geologist in Capetown, who pronounced them highly radio-active. At that time radium had not received the same publicity as it has of late, and the occurrence being far in the interior, was allowed to be overshadowed by the more exciting finds of diamonds. The recent statement published in all the papers regarding the desirability of a supply of radium being discovered within the British Empire naturally aroused interest in the forgotten find in South West Africa.

TORONTO

March 18.

Porcupine.—Production in this field is well maintained, the output of bullion for February being valued at $1,463,684, as compared with $1,439,161 for the corresponding month of last year. The conditions in the central portion of the Hollinger at depth show improvement. An important high grade vein on the 2,400 ft. level of the Schumacher section has been opened up. The mill is treating about 4,000 tons daily. The annual statement of the Dome Mines, Ltd., shows profits of $1,939,222, and a surplus at the close of the year of $2,362,605. The ore reserves are estimated at 1,250,000 tons, more ore having been put into sight during the year than the tonnage milled. Work in the greenstone area at depth has opened up some important orebodies. The mill is handling about 1,500 tons of ore a day with an average recovery of $7.15 per ton. The mill of the Vipond Consolidated is now treating 265 tons of ore a day with mill heads averaging $8 per ton. Underground work is proceeding with satisfactory results, a large orebody having been opened up on five levels, with a probable downward extension. Drifting is being done to intersect veins believed to come in from the Hollinger. At the instance of the bond-holders the Coniaurum Mines, Ltd., has been placed in receivership, Fraser Reid the manager having been appointed receiver with authority to borrow sums up to $50,000 to carry on the work. Owing to disappointing results at the 2,000 ft. level the returns were not sufficient to finance development work. The mill has been handling about 300 tons of ore per day. The mill of the West Dome Consolidated which was reopened in January, its capacity having been increased to 125 tons, is now in steady operation. Development work has encountered a large body of low grade ore on the 1,050 ft. level. The Porcupine United Gold Mines is operating the Canadel where a shaft has been sunk to a depth of 497 ft., and five levels established. A 100 ton mill has been erected which will be operated by electric power. The Paymaster, the mill of which was closed down after an unsuccessful attempt to treat a large body of low grade ore unprofitably is conducting a diamond drilling campaign in the hope of finding richer ore, which is understood to have been attended with some success.

KIRKLAND LAKE.—The February output of the Kirkland Lake camp was valued at $1,151,710, as compared with $964,830 for February of last year. The average monthly production during 1928 was valued at $1,022,592. Additions to the mill equipment at the Lake Shore has increased its capacity to 1,300 tons per day, with mill heads running from $18 to $20 per ton. The new shaft which has been completed to 1,600 ft. in depth, and is being continued to 2,000 ft. has a capacity for 2,000 tons of ore a day, and the No. 2 shaft is capable of raising a similar tonnage. The ore crushing equipment is equally in excess of present requirements leading to the expectation that milling facilities will shortly be considerably increased. The mill of the Wright-Hargreaves is treating about 700 tons daily and underground conditions have latterly shown a marked improvement. A new vein has been discovered on the 2,000 ft. level, which has been opened up with encouraging results. Operations at the Sylvanite have definitely determined a wide vein paralleling the main deposit, the continuation of which has been proved by diamond drilling to a depth of 1,750 ft., and it is being opened up by lateral work on the upper levels. The Teck-Hughes is actively pushing its campaign of development at depth. The Central shaft will reach its objective of 3,000 ft. within the next month or so. Following this the development of six new levels will be conducted from this shaft. Meanwhile the new shaft will be driven straight through from surface to 3,500 ft. in depth and, with plans for a second stage in sinking to a possible 7,000 ft., this shaft will take care of all developments below 3,000 ft. At the Murphy development has indicated an important tonnage of ore. A cross-cut is being run at the 600 ft. level towards a wide vein of commercial ore indicated by diamond drilling. The shaft of the East Maine has been put down 125 ft. on a mineralized zone yielding good assays. A station will be cut and lateral work undertaken. The Amity Copper which has made several shipments of high grade ore to the Noranda smelter has cut a vein 14 ft. wide on the 600 ft. level, which is being opened up and showing good values.

ROUYN.—The outstanding feature of the annual report of the Noranda Mines, Ltd., is the enormous growth of the ore reserves, which are estimated at 3,097,000 tons of the value of $79,340,000. During the year the smelter treated 271,926 tons of ore, and produced 33,307,937 pounds of blister copper, the average analysis of which was 99·27% copper, 11·20 oz. of silver, and 3·18 oz. gold per ton. Operating profits amounted to $3,018,247. After making all deductions there remained $1,657,991 to the credit of profit and loss. At the Abana an important new orebody has been encountered by diamond drilling at a depth of 500 ft. The ore reserves are estimated at 104,700 tons. The shaft of the Siscoe gold mine now down 500 ft., will be put down to the 700 ft. level where diamond drilling has indicated an important zone of commercial ore. The mine made its first shipment of bullion last month, valued at $35,000. At the Granada-Rouyn lateral work is being carried on at three levels, which are yielding good ore. A large amount of visible gold has been disclosed, and the drifts are still some distance from the point where the diamond drill indicated good values.

SUDBURY.—As a result in the recent revival of interest in nickel and copper many new enterprises have been undertaken and prospecting has been very active. This has been especially noticeable in the territory along the strike of the nickel-bearing eruptive which encircles the Sudbury Basin, where some 300 claims were recorded during February. The great expansion of the nickel-copper industry is shown by the annual report of the International Nickel Company for 1928, showing net earnings of $12,557,970, as compared with $6,334,772, for the previous year. After making all deductions the total surplus at the end of the year was $33,169,819, an increase of $14,306,316. The three new units which are to be added to the company's plant at Port Colbourne, will practically double its facilities for the production of electrolytic zinc, the capacity of each unit will be 1,200,000 pounds per month. Treadwell Yukon, has proved ore under development for 11,000 ft., east of the original discovery. Diamond drilling has been started to test the continuation of the ore at depth in the central section. The mill is now treating 270 tons of ore per day producing about 40 tons of concentrates. The Sudbury Nickel and Copper has taken an option on the Strathcona, which joins the Levack Mine of the Mond Nickel Company, now owned by the International Nickel of Canada, and will start a diamond drilling campaign. Plans are in preparation for the

smelter of the Falconbridge which will have an initial capacity of 200 tons per day. It is expected to be in operation by the end of the year. Diamond drilling has indicated a good grade of ore over an important width.

MANITOBA.—The orebody at the Flin Flon Mine has been proved to have a length of half a mile, with an average width of 70 ft. above the 900 ft. level, which is as far as diamond drilling has been carried. The company has placed large contracts for machinery for the mine and mill, as well as for the power development at Island Falls, work on which is making good progress. At the Mandy work is proceeding on three levels, and a strike regarded as important has been made on the 875 ft. level. The mine was a considerable producer during the war, but was closed for some years on account of transportation difficulties, which have now been remedied by the construction of the Flin Flon branch line. A force of 200 men are at work on the Sherritt Gordon where a third shaft is being put down. An ore length of over two miles has been indicated, with an estimated value of $20,000,000, for every 100 ft. in depth. A ten ton test mill is being brought in, and will be in operation early in the summer. Production at the Central Manitoba Mines is holding about steady and runs between $50,000 and $60,000 per month. Drifting on the lower levels has been disappointing in results, and it is proposed to sink the shaft an additional 250 ft. On the Tene 6, which is three-quarters of a mile east of the main Kitchener shaft, the auxiliary shaft is down 250 ft., ore being disclosed for the entire distance. Cross-cutting has proceeded for a distance of 350 ft., encountering ore carrying $12 to $14 to the ton.

PATRICIA DISTRICT.—With the break up of winter the water routes will become available and activity in this field will be greatly increased. Interest has latterly been largely centered on the new camps at Shoniah Lake, and Crow River, where numerous new discoveries have been reported. Some of the established companies have become interested in this field including the McIntyre Porcupine, Nipissing, Bunker-Hill Extension, and Mining Corporation of Canada. One of the richest recent finds has been made at the Bobjo in the Clearwater Lake section, where a shaft is being put down and a mining plant is to be brought in. Development is being actively carried on at the Howey, and Red Lake Center mines, with encouraging results.

VANCOUVER

March 9.

THE KOOTENAYS.—Though the Consolidated Mining and Smelting Company of Canada's estimated net profit for 1928 was only $739,000 less than in the previous year, its estimated net earning was $2,566,300 less, the difference being accounted for by smaller investment in new properties. The smaller earning is due to lower metal prices; operating costs were less and output was greater than in 1927. The company reports that operations are proceeding satisfactorily at all properties, though somewhat affected by the severe weather conditions.

St. Eugene Extension Mines has been formed to acquire a consolidation of claims, including the Aurora, Cambrian, and Guidon groups, situated on the opposite side of Moyie Lake to the St. Eugene mine. The new company has made arrangements with the Consolidated Mining and Smelting Company for the use of the Lake Shore shaft of the St. Eugene, which is 740 ft. deep. From the bottom of the shaft, a drift will be run under the lake, 4,000 ft. to the properties. This will explore the vein under the lake and will serve as a main haulage level, as arrangements have been made with Consolidated to treat the ore in the St. Eugene mill. Consolidated also will supply the new concern with electric power. Two veins have been worked in the St. Eugene, and two veins, a similar distance apart, have been opened on the claims on the other side of the lake. There is little doubt but that they are the extensions of the St. Eugene veins. The Wilson interests, headed by Mr. W. R. Wilson, president of the Crow's Nest Pass Coal Company, are the chief backers of the new company. Mr. Ridgeway R. Wilson is general manager.

United States interests are re-opening the Krao mine, near Ainsworth, which in its early operations produced a considerable tonnage of ore some of which ran unusually high in silver, but which has been unproductive for many years. During the war, Mr. A. W. McCune, of Salt Lake City, a previous Kootenay operator, took a lease and option on the property, drove a tunnel to explore it at greater depth, and drifted for 1,000 ft. along the footwall of the limestone belt, in which the ore occurred in the

upper workings, but failed to find commercial ore. Mr. W. E. Zwicky, who is looking after operations for the new syndicate, contends that the best ore in the Krao always has been found on the hanging-wall side of the limestone belt, and he proposes to run cross-cuts from the McCune drift to explore the hanging-wall. The limestone belt is about 60 ft. wide.

Noble Five Mines has run into high-grade milling ore in a drift on No. 8 level on the Noble Five vein. The drift has been run on the shoot for 60 ft. with its face still in ore. Assay returns from the first samples averaged 10 oz. of silver per ton, 7% lead, and 18% zinc. The vein is 6 ft. wide; ore taken out in development is being milled with development ore from the Deadman shoot. A 12 ft. shoot of high-grade milling ore has been opened in a raise between levels 13 and 14 at the Whitewater mine. The ore is expected to average 30% mixed lead and zinc, with the latter predominating.

Grand Trunk Pacific Mineral Belt.—Silver Cup Mines, formerly the Duke Mining Company, has put its new 50-ton mill and 4,000-foot tramway into operation. The mill is operated electrically, current being generated by a 175 h.p. Fairbanks-Morse oil engine. Owing largely to the condemnation of a bridge, which necessitated hauling the machinery a longer distance, the cost of the plant overran the original estimate. A group of shareholders found the necessary funds, and, to reimburse them, the capital of the company has been increased to $375,000 by the creation of 250,000 new shares at 50 cents. The shareholders mentioned are taking their advances in shares, and 200,000 shares will be left in the treasury to meet any unforeseen contingency.

At the annual general meeting of Duthie Mines, shareholders endorsed the arrangement entered into with the Atlas Exploration Company and Mines Issues, of Toronto, whereby the Toronto companies have taken 350,000 shares of the new issue at 50 cents and are given an option on the remaining 650,000 at the same price. Dr. J. Mackintosh Bell and Mr. H. J. Acres were added to the directorate to represent the Toronto interests. The electrification of the mill and mining plant and the erection of the new camp at the Mill tunnel of the company's Henderson mine have been completed.

Portland Canal.—The Woodbine Gold Mining Company, which has been much before the public on account of the extravagant estimates of the ore reserve developed at its property adjoining the Premier mine, held its annual meeting recently, when the whole outlook was discussed. A payment of $50,000 falls due on the property on March 20 and one of $150,000 on December 20, next. Messrs. R. H. Stewart, Batten and Associates, who have been acting as consultants, advised the closing of the mine, as no commercial ore has been developed either by diamond drilling or underground work. The meeting decided to ignore this advice if better terms could be made with Mr. Hugh McGuire, the vendor, and adjourned for the directors to negotiate with him. The upshot of the negotiation is that Mr. McGuire has agreed to accept for the property $35,000 in spot cash, $5,000 worth of shares at 7½ cents, $60,000 worth at 10 cents, and $100,000 cash and 7% interest thereon from January 1, 1930, both capital and interest to be paid out of smelter returns, 20% of all such returns received to be set aside for this purpose. These terms were accepted at the adjourned meeting of the company, and it was decided that the exploration of the property shall be continued. With the exception of Mr. S. Burke, former president, the old board of directors retired and a new board was elected. Captain Charles Hutton, of London, was elected to represent investors in Great Britain.

The Weather.—Exceedingly cold, dry weather throughout the Province, but, curiously, more particularly in the southern than the northern part, has curtailed mineral production appreciably during the first two months of this year, and, unless, there is an unusually heavy rainfall during March and April, it is to be feared that a water shortage will be likely adversely to affect production later in the year. At the coast, the rainfall for January and February was only one quarter to one-third that of the normal fall and in the interior it is believed to have been little better. So serious is the situation that the B.C. Electric has been operating its auxiliary steam plant at full capacity since the end of January, and it has notified its customers that, unless there is a heavy and continuous downpour, they must be prepared to make serious sacrifices in the matter of light and power.

BRISBANE

February 18.

Last Year's Operations.—Complete official returns of the mineral production of the Australian States for 1928 are not yet available, but as far as Queensland is concerned statistics show a declining output. The biggest falling off is in gold, the result mainly, but not entirely, of the cessation of production at Mount Morgan. Regarding the general mineral output, there should be a decided improvement in the near future. The Mount Isa Company should begin production early next year, and the Mount Elliott Company very shortly, the former turning out lead, zinc, and silver, and Mount Elliott copper. Of tin, the operations, already initiated, by the Whitworth and Finance Mining Corporation, the newly started dredging projects, all in the Herberton district, the premier tin-field of the State, should also result, before long, in increased returns. Even with the assistance of these enterprises, however, it is admitted that the position of the mining industry of Queensland, in view of its great potentialities, will not be what it should be. This fact is recognized by the State Government, and the Premier (Mr. W. M'Cormack) has now announced the decision to have an investigation into the possibility of reviving metalliferous mining in the North, and to appoint an expert commission to make such an investigation. The inquiry will be on a twofold basis—the geological-metallurgical and the industrial.

A Coal Crisis.—The coal industry in Queensland has continued to fall back during the past year, and in the adjoining State of New South Wales the position reached a crisis the other day, when the scheme for reducing the selling price by 5s. a ton propounded by the Premier of that State (Mr. T. R. Bavin) collapsed through the refusal of the unions concerned to agree to any reduction of wages. Thereupon, the Prime Minister (Mr. Bruce), who had promised that the Federal Government would contribute 1s. a ton to the 5s. in the shape of a bounty, promptly withdrew his offer. This was not surprising, seeing that the proposed Federal bounty was to operate with regard to only New South Wales coal for both inter-state and overseas export—a proposal obviously unfair to other States producing coal, such as Queensland and Tasmania. It is certain that both the New South Wales and Victorian Governments will not continue to take coal supplies from Newcastle (N.S.W.) under existing conditions, but will be forced to seek them from Great Britain, whence, it has been stated, they can be obtained at from 7s. to 10s. a ton less than the Newcastle price. If this be done it will mean a loss in turnover by the New South Wales collieries of over £2,200,000 annually. The latest development is that the associated mine owners in the Newcastle and Maitland districts have given a fortnight's notice of dismissal to their employees, involving about 11,000 men, presumably with the intention of re-employing them only on conditions as to wages and other matters stipulated by the proprietors.

The Mount Elliott Company.—In connection with the proposed resumption of operations by the Mount Elliott Company in the Cloncurry district, the Queensland Premier has announced that negotiations between the company and his Government have been concluded for the construction of a motor road, some 72 miles in length, between Dobbyn, the terminus of the railway from Townsville, to the company's best mine (Mt. Oxide); also for special reduced rail rates, as well as for strong support by the State Government of a petition to the Federal Government urging the free importation of mining machinery. Mount Oxide is so remotely situated that, without either such a road or railway extension, it would have been impossible for the Mount Elliott Company to have carried out that part of its programme as mapped out, which provides for the production from the Mount Oxide property of oxidized ores at the rate of 200 tons daily. The granting of special rates on the Queensland railways is not new. For the past six years, the copper gougers working on the Cloncurry field have been allowed a rebate of 75 per cent., without which it would have been impossible for those miners to carry on. Railway concessions have also been granted to the Mount Isa Company, operating in the same district. The acquisition by the Mount Elliott Company of the plant of the Hampden-Cloncurry Mines, Ltd., in liquidation, provides the former body with smelting works more centrally situated than its own old plant at Selwyn.

Mount Isa Activities.—The important work of constructing the Mount Isa dam at Rifle Creek continues to proceed satisfactorily. Early in December the wall had reached a height of 30 ft., more than

half of its intended elevation. Good rains had then fallen, and on the 6th of the month there was about 20 ft. of water in the reservoir. Later there were further falls of rain throughout the Cloncurry district, and by now the dam has no doubt been further heightened and more water stored. It is expected that both the dam and the railway from Duchess to the mines will be finished by March. Mr. A. C. Mitke, the American expert in the mining of large ore-bodies, was engaged during the past month in investigating the conditions on the Black Star lode, with a view to evolving what the local mining warden describes as a safe and economical system of working that mine. The result, according to that official's last report, will probably be the adoption of a method of mining new to Australia. At latest reports, Davidson's shaft, in the Black Star section, was 281 ft. deep—1 ft. below where the sulphide zone was entered. On the experimental stope, work at the 80 ft. level, having met the conditions necessary for the plan of campaign laid down by Mr. Mitke, was stopped. At the Rio Grande, rises were well advanced, preparatory to the opening up also of a stope there.

Cloncurry Ore.—With the help of the 75% rebate on rail rates granted in the past six years, the copper gougers, or miners, of the Cloncurry district have been sending away monthly considerable quantities of copper ore, high in grade, and should have been doing very well. Their lot will doubtless be much improved by the continuing rise in the price of copper, which has now reached over £80 a ton for standard. True, those who hold tributes on the leases belonging to the Mount Elliott Company will lose them when that company resumes operations on its own account, but, on the other hand, this resumption will mean regular work for many miners and other men at good wages, and must tend generally to add to the prosperity of the field. Most of the ore mined by these men is bought for the Port Kembla works, in New South Wales. That from tributers in the Mount Oxide mine, however, is despatched direct to Europe. The last lot sent from this mine, consisting of 124 tons, averaged as high as 44% copper, having a value of the field of £17 5s. a ton. A large proportion of the ore from other mines exceeded 25% in grade.

North Queensland Tin.—Heavy rains that have recently fallen in North Queensland will be a great help to the Herberton tinfield. The Great Northern Freehold mine, in this district, with a history extending back for nearly half a century, has of late been again coming into prominence, following one of its temporary uneventful periods. The cause is the finding of yet another lode formation, carrying rich patches of tin. The tin-bearing face measures 5 ft. by 5 ft., carrying 15% of tin over the full face, with ore of a somewhat lower grade underfoot. The new discovery is significant as opening up entirely new country, where tin had not been previously discovered, and is considered the most important since the formation, a number of years ago, of the company now owning the property.

CAMBORNE

April 3.

Cornwall County Bill and the Mining Industry.—As the result of the vigorous opposition and petitions of the Cornish Chamber of Mines and other bodies, certain objectionable clauses in Part VIII of the Cornwall County Bill have been deleted, and in consequence the mines and china-clay works will continue to enjoy their ancient rights and privileges. It is a great pity that the County Council authorities did not adopt a more conciliatory attitude *before* the question reached the House of Lords Select Committee. If they had done so, the very heavy legal and other costs for which both the petitioners and Council are now responsible, would have been avoided. Doubtless the Chamber of Mines, with small funds, will be compelled to make an appeal for financial assistance.

Uranium and Radium Possibilities in Cornwall.—The radium report of the Civil Research Committee is, it is assumed, now in the possession of the Government. Perhaps this will help to draw attention to the possibility of increased supplies from Cornwall. Uranium-bearing minerals are widely distributed in Cornwall, the chief varieties being pitchblende, autunite, and torbernite, these usually occurring in small "bunches" in the lodes of tin and copper. Pitchblende has been found in many Cornish mines and years ago, when little or nothing was known of the properties of radium, it was regarded as a nuisance and discarded. A systematic examination of the mine dumps

or " burrows " of Cornwall would, no doubt, result in the finding of specimens of uranium-bearing minerals. The most noteworthy occurrences of uranium ores in Cornwall are those of the South Terras and Trenwith mines. During a recent examination of a large number of old records of Cornish mines the writer came across some very interesting information concerning the occurrence of pitchblende in lodes which were being chiefly worked for copper ore.

CENTENARY OF SIR HUMPHREY DAVY.—In honour of this world-famous Cornish scientist, who died on May 28, 1829, it is proposed to hold a commemorative gathering on June 8 at Penzance. The Royal Geological Society of Cornwall (of which Sir Humphrey was a member) and the Royal Institution of Cornwall are organizing the meeting and it is anticipated that Sir Humphrey Davy Rolleston, one of the King's physicians, who is a lineal descendant of his illustrious namesake, will be present. Davy is, of course, chiefly remembered for his invention of the miner's safety lamp which bears his name. The placing of a memorial wreath on his statue in Market Jew Street, Penzance, will form part of the commemoration.

GEEVOR.—Mr. F. C. Cann, the popular manager of Geevor, has returned to take up his duties at the mine, after a trip abroad in search of health and it is pleasant news to hear that he is now quite fit.

RISE IN PRICE OF LEAD.—The recent rise in the price of lead, if maintained, might possibly result in a revival of lead mining in Cornwall and Devon. It should not be forgotten that some 60–80 years ago the West of England occupied a very important position in the production of lead ore. In the opinion of engineers who have had occasion to study the mineral resources of the two south-western counties, the deposits of lead ore are by no means worked out. The abandoned lead mines are not so deep as those of tin and copper and another favourable factor is the fact that the Cornish and Devon lead ores contain silver in considerable quantity.

WHEAL ANDREW.—It is stated that a company called Argus Concessions, Ltd., have taken up a mining option on a fairly large tract of ground covering the Wheal Andrew sett in Gwennap parish.

POLHIGEY.—The new mill is now in operation.

PERSONAL

A. W. ALLEN passed through London last week on his return to the United States from the Continent.

H. E. ARROWSMITH has opened an office at 52, Archer Street, Notting Hill, W. 11, to practise as consulting metallurgist, assayer and analytical chemist.

H. FOSTER BAIN is visiting Colombia to serve as a consultant to the Colombian Government in the consideration of a revision of the petroleum mining laws of that country.

F. O'D. BOURKE is home from Nigeria.

FREDERICK W. BRADLEY is the new President of the American Institute of Mining and Metallurgical Engineers, and EDGAR RICKARD and HENRY A. BUCHLER the new Vice-Presidents.

C. B. BRODIGAN has returned from a visit to the East.

L. MAURICE COCKEREL has left for Texas.

NORMAN R. FISHER is the President-Elect of the Canadian Institute of Mining and Metallurgy.

HALL AND RAINE have moved from 20, Copthall Avenue, to Dunedin House, Basinghall Avenue, E.C. 2.

SIR THOMAS HOLLAND left last month for Colombia.

G. C. KLUG has left for Australia, *vid* America.

ROSS MACARTNEY has returned from Burma.

MALCOLM MACLAREN has returned from the East.

HUGH F. MARRIOTT has returned from Panama.

JOHN MARTIN has been elected President of the Transvaal Chamber of Mines and SIR WILLIAM DALRYMPLE and J. H. CROSBY Vice-Presidents.

F. MAXWELL-STUART has left for Peru.

E. D. METCALFE has been elected a director of Murex, as nominee of Imperial Chemical Industries, Ltd.

ALFRED OTTER has left for Northern Nigeria.

FRANK B. POWELL has left for West Africa.

T. PRYOR has left India for Tanganyika and expects to return to England in June.

J. F. W. ROWE is returning from Nigeria.

JOHN SMEDDLE has returned from California to Nicaragua.

SIR EDWIN A. SPEED and Messrs. A. W. BERRY and G. T. BROADBRIDGE have been re-elected Chairman and Deputy-Chairmen respectively of the Nigerian Chamber of Mines.

G. A. STOCKFELD has left for South Africa.

G. GORDON THOMAS is returning next month from South-West Africa.

A. SPENCER CRAGOE died on March 19, in London, from pneumonia following influenza.

MAJOR F. B. LAWSON, who was chairman of the Renong and was on the board of a number of other Eastern and South African companies, died on March 28.

TRADE PARAGRAPHS

G. A. Harvey and Co., Ltd., of Woolwich Road, London, S.E. 7, send us a copy of their standard catalogue of perforated metals together with leaflets devoted to other metal plate work.

Ruston and Hornsby, Ltd., of Lincoln, have issued a new brochure on excavating machinery which is fully illustrated with photographs and diagrammatic pictures showing shovels and drag-lines engaged in a great variety of operations.

Westinghouse Electric International Co., of 2, Norfolk Street, London, W.C. 2, send us the February-March issue of their house organ, which contains a brief description of petrol-electric locomotives of from 12 to 45 tons for mine haulage.

The W. S. Tyler Co., through their agents, **International Combustion, Ltd.,** of 11, Southampton Row, London, W.C. 1, have issued a leaflet describing the Ro-Tap testing sieve shaker for use with sets of standard Tyler sieves in the laboratory.

Bolckow, Vaughan and Co., Ltd., of Middlesborough, have issued a splendidly prepared booklet covering some 45 pages (quarto), and illustrated, which describes their works, immense organization, and products, including steel, iron, coal, ferro alloys, basic slag, and firebricks.

Robey and Co., Ltd., of Lincoln, publish a catalogue devoted to horizontal and vertical steam engines, steam and electric winding engines, oil engines, air compressors, steam wagons, tractors, and crushing machinery, which gives a clear conception of the variety of their products.

Kinetic Elutriators, Ltd., of 11, Southampton Row, London, W.C. 1, inform us that through **International Combustion, Ltd.,** the following orders have been received: 3 Andrews classifiers of 800 lb. per hour overflow (99 9% through 220 mesh). This is a repeat order from the ceramic industry in England. One classifier for China to overflow 2,000 lb. per hour (99% through 100 mesh).

Evershed and Vignoles, Ltd., of Acton Lane Works, Chiswick, London, W. 4, publish a catalogue of electrical instruments of all kinds, including ammeters, voltmeters, and wattmeters, recording instruments, resistance measurement equipment, and the Midworth distant repeater for remote control of power-driven plant, or for recording at a distance, and in several places simultaneously, the movement of any part of a plant.

Sandycroft, Ltd., of 4, Broad Street Place, London, E.C. 2, issue a catalogue of water turbines (reaction and impulse) and accessories, the manufacture of **Aktiebolaget Finshyttan**, of Sweden. This contains many photographs of water power schemes and diagrammatic sections of typical plants. It is divided into sections among which are the following: Vertical shaft, horizontal shaft, double runner, cased, cased double, and spiral cased turbines; Pelton wheels; waterways; pipe lines; and valves.

International Combustion, Ltd., Grinding and Pulverizing Offices, of 11, Southampton Row, London, W.C. 1, report that new orders have been received for the following equipment:— For England: Three 7 ft. by 36 in. Hardinge pebble mills and three Andrews classifiers for ceramics; one 3 ft., Type 37, 1-surface Hum-mer electric screen for cocoa liquor; and one 4 ft., Type 37, 2-surface Hum-mer electric screen for slag. For India: One 7 ft. by 48 in. Hardinge ball mill for lead-zinc ore. For Australia: Two 4 ft. by 5 ft., Type 39, Hum-mer screens for lead-zinc ore; two 8 ft., Type 39, Single-Body Tandem and two 4 ft., Type 39, Single-Body Tandem Hum-mer electric screens for coal. For South Africa: One No. 0000 Raymond pulverizer for coal. For Norway: One 4 ft. by 7 ft., Type 39, Hum-mer screen and two 4 ft. by 5 ft., Type 39, Hum-mer screens for granite. For France: Twelve 8 ft. by 60 in. Hardinge ball mills for coal and coke; one 3 ft. by 18 in. Hardinge ball mill for coke; one 3 ft. by 18 in. Hardinge pebble mill for felspar; and one 2-Roller Raymond mill for unknown duty. For Austria: One 3-Roller Raymond mill for talc. For Spain: One 5-Roller Raymond mill for phosphate. For Italy: One No. 00 Raymond pulverizer for talc crystals.

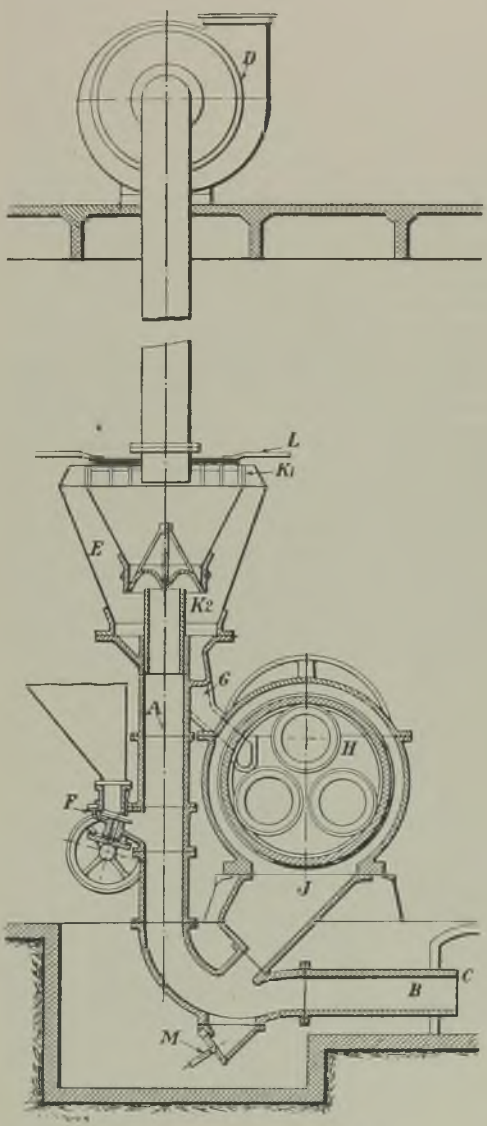
Geophysical Co. [Elbof] (Piepmeyer and Co.), of Kassell, Germany, and 668, Salisbury House, London, E.C. 2, have about fifty engineers engaged on work in different parts of the world. Altogether there are ten groups and geophysical surveys are being carried out in the United States; East, South-West, and South Africa; Australia; New Zealand; Java, and elsewhere. A short note regarding the Company's activities in Africa may be of interest. A seismic group has just completed a survey on a geological structure in East Africa resulting in the location of a flat anticline. The survey will be resumed again after the rainy season. A party employing electrical methods of investigation has been working at Gibeon in South-West Africa for oil in the neighbourhood of a tertiary dome located geologically. The results are structurally interesting but so far there are no indications of a bad conductor. The same group are now engaged on a water investigation at Luderitztown in South-West Africa. The conditions are satisfactory and some promising results are expected. Dr. Heimburg, the company's chief technical engineer in South Africa, is engaged with a party on a contract for the South African Mineral Co., near Rustenburg. The ore is a nickeliferous-magnetite which lends itself to investigation by magnetic methods. The magnetic survey will be followed by a geo-electrical investigation by the induction method. A new contract with the Messina Mine in the Northern Transvaal has just been entered into. In addition to new ground the survey will include a part of the area which had been subject to general investigation during the first contract.

British Wood Impregnating Co., Ltd., of 30, Norfolk Street, London, W.C. 2, send us a booklet giving a brief account of the Wolman system for timber impregnation. This system makes use of dinitrophenol, sodium fluoride, and another salt which is stated to prevent the solution from attacking metals. This compound, termed "Triolith," is claimed to be fire-resisting, and is used in much the same way as creosote, the equipment required being practically identical. A typical plant consists essentially of a mixing tank in which the "Triolith" solution is prepared; an impregnation cylinder; a pressure chamber, to feed the solution into the impregnation cylinder as absorption takes place; a storage tank below ground level; and a ram pump capable of dealing with pressures from 5 to 9 atmospheres. In some instances an old Lancashire boiler serves as the impregnation chamber. An ordinary 30 ft. by 8 ft. boiler will hold about 600 cu. ft. of timber, which is equal to about 800 props 6 ft. 6 in. long and from 8 to 9 in. in diameter. Heating pipes are provided to keep the solution at a temperature of 90° C. After the end plate has been bolted in position and the joints sealed, the air is exhausted from the impregnation chamber and the vacuum maintained for half an hour. The "Triolith" solution is then drawn into the clyinder, and the pressure chamber is also filled. A pressure of from 5 to 9 atmospheres, depending on requirements, is maintained in the pressure chamber, which is connected to the impregnation cylinder. The pressure is maintained until the timber has absorbed 1 gallon of solution per cu. ft. of wood,

the rate of absorption and total quantity absorbed being observed by means of simple instruments. When the process is complete the surplus solution is run into the storage tank and the timber stacked in the yard to dry. Reduction by 20% in the quantity of timber props in use in a Ruhr colliery is claimed as a result of this impregnation.

REMA PULVERIZING MILL.

In these columns reference was made last month to this mill in connection with the Brand system of powdered fuel firing and here follows a description of it. The mill was introduced by the Rheinische Maschinenfabrik A.G., of Neuss am Rhein, Germany, and is manufactured in this country by the British Rema Manufacturing Co., Ltd., of Halifax, under the control of William Asquith (1920), Ltd. The grinding elements consist of three rollers which work in a vertical plane against an encircling ring, against which they are held by heavy spiral springs. The system of spring-held rollers is intended to provide compensation for wear. The accompanying section will serve to illustrate the operation of the complete unit. Material to be crushed is delivered into the air pipe *A*, through the feeder *F*, whence it is pneumatically conveyed. At the entrance to the lower part of the sifter the deflecting cone K_2 tends to deliver the material into the chutes *G*, and since the velocity of the air current is reduced, due to the increased area in the sifter, only fine particles of material are carried through to the inner cone. The larger pieces fall down the chutes *G* and are fed in at each side of the mill *H*, thereby ensuring even distribution across the inner face of the grinding ring which results in maximum output being obtained with minimum wear on the ring. The rollers pulverize the material, which passes out of the mill outlet *J* into the pipe *A* where it is entrained in the air current and again carried along together with the raw material being fed into pipe *A*, to the sifter, where the larger pieces are delivered to the mill and the finer particles carried up the space *E* between the inner and outer cones. At the entrance to the inner cone a series of adjustable vanes are fitted to the openings K_1, which impart a centrifugal action to the dust particles entrained in the air current and the final separation is completed in the inner cone, only the very fine dust being carried out of the system by the fan *D*. The coarser particles fall down inside the inner cone partly by centrifugal action and partly due to gravity, to be automatically returned to the chutes *G via* discharging flaps for re-grinding in the mill. The necessary air current is induced by the high efficiency fan *D* which is placed in the layout of the system after the pulverizing mill and sifter. The air current passes up pipe *A* into the space *E* between the inner and outer cones of the sifter, after which it is admitted to the inner cone *via* openings K_1, arranged round the upper part of the inner cone. From the centre of the inner cone a pipe is taken to the inlet of the fan *D*, the outlet of the fan being connected by means of piping direct to the burner, in the case of powdered fuel systems adopting direct firing. If the powdered material is required to be stored in bins or collected into sacks, casks, or other receptacles, the fan outlet is connected to a cyclone separator and the system can then be arranged so that the air is returned from the cyclone separator to the pipe *A* by suitable piping, and the powdered material delivered to suitable receptacles. The pipe *A* may be left open to the atmosphere at its end *B*, or alternatively coupled up with a source of hot air (represented by *C*) if the material requires drying. The degree of fineness is regulated by the setting of handle *L* which adjusts the vanes at the entrance to the inner cone, thus controlling the centrifugal separating action of the air current



Section of Rema Mill.

inside the sifter. There are no revolving parts inside the sifter, and once the regulating handle *L* is set to give the required degree of fineness, no further attention is necessary. Material which is too heavy to be lifted by the air current falls down to the lower part of pipe *A* where it is easily removed by opening the trap *M*. Foreign materials, whether magnetic or non-magnetic, are thus prevented from entering the mill.

HELE-SHAW BEACHAM AIR MOTOR

The principle underlying the machine here described is the same as that of the air compressor of this name, details concerning which were published in the MAGAZINE for December, 1925, and January, 1926. It will be recalled that Holman Bros., Ltd., of Camborne, were the manufacturers of the compressor. Test and development of the original machine have been continued in the intervening years as a result of which the air motor has been evolved. From the accompanying sections it will be seen to consist of three cylinders formed in one casting which rotates on ball and roller bearings about the fixed central valve, in which the inlet and exhaust passages are formed. The pistons are carried by roller bearings on floating annular rings, the centres of which are eccentric to that of the valve. Therefore when the cylinder rotates the pistons move relatively to the cylinder, and the same process of air cut off, expansion and compression, which take place in the ordinary type of reciprocating machine are present in this one.

The air enters the valve by way of the air filter A and valve chest—Fig. 3—passes along the inlet passage F, and enters the cylinders through ports cut in the cylinder head—Fig. 1. The air thrust on the piston forces the gudgeon pin rollers against the floating ring, and as this track, except at the ends of the strokes, is not perpendicular to the thrust, the piston is moved along it, and so rotates the cylinder. Before the end of the stroke, the air is cut off and expands in the cylinder, until just before the end of the stroke, when the exhaust port opens and air is discharged to atmosphere through the passage K, Fig. 1. Towards the end of the exhaust stroke, the exhaust port is closed, and air is compressed into the clearance spaces, so that on

FIG. 1.—SECTION THROUGH CENTRE LINE OF AIR MOTOR.

opening the inlet port, there is no loss of pressure due to filling the clearance spaces with compressed air. To obtain a reversal of the direction of rotation the central valve is moved by a control lever into the position shown on Figs. 4 and 2, so that the inlet and discharge ports are now on opposite sides of the vertical centre line, but exactly in the same relative position. Thus the cylinders will revolve

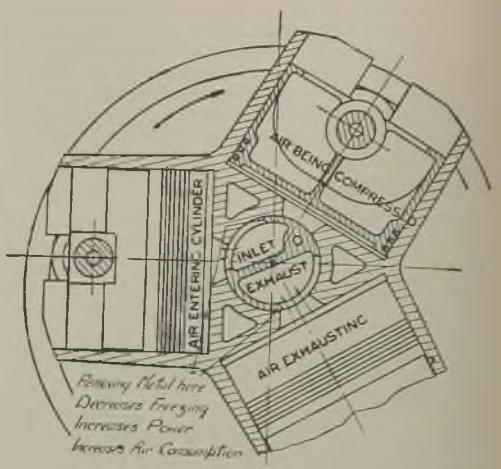


FIG. 2.—SECTION THROUGH CENTRE LINE OF AIR MOTOR.

in the opposite direction to which they did before. When the valve is halfway between the forward and reverse positions (Fig. 5) the ports in the valve chest are cut off from the air supply, and so the motor stops. The valve is so designed that the control lever may be changed from the forward to reverse position, without any pause in the stop position. Its operation is thus foolproof.

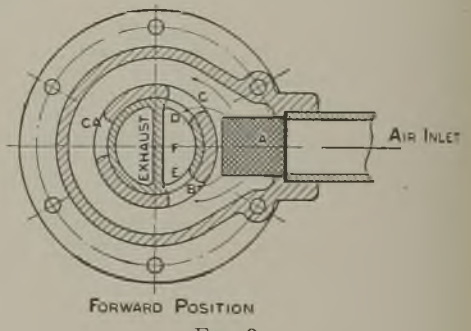


FIG. 3.

The following performance figures are of interest: The motor will run at high speeds without vibration. The normal speeds vary from 1,500 r.p.m. at 15 h.p. to 1,000 r.p.m. for the 45 h.p. using air at 80 lb. per sq.in. pressure. The oil consumption is low. In a continuous test in a mine the 15 h.p. motor lost only ¼ pint of oil in 264 hours continuous working.

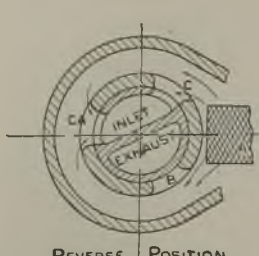


FIG. 4.

FIG. 5.

METAL MARKETS

COPPER.—Further violent advances occurred in copper prices during March, the export quotation for electrolytic soaring in New York from 19·50 to 24 cents per lb. Panic caused consumers to buy frenziedly, and producers quite lost control of the position. Naturally, there is a feeling amongst the more level-headed interests that prices are now too high, but as stocks of refined copper are low, a reaction may prove to be slow in developing. Consumers are beginning to switch over to the use of aluminium and other substitute metals wherever possible and eventually this should help to get the market into a healthier condition. Copper producers may eventually find, however, that consumers who have gone over to the use of other metals may not easily be persuaded to return to copper. At present, nevertheless, the big interests are in a sufficiently strong position not to worry about the immediate future and the prices they are now securing for their output are extraordinarily remunerative.

Average price of Cash Standard Copper: March, 1929, £89 4s. 4d.; February, 1929, £78 5s. 10d.; March, 1928, £61 3s. 6d.; February, 1928, £61 14s.

TIN.—Whereas the other non-ferrous metal markets experienced feverish and firm conditions during March, especially during the middle and latter part of the month, the tin market presented an extraordinarily placid aspect. Values were virtually unaltered, on balance, and such fluctuations as were seen were of a comparatively minor nature. The fact that tin is usually the most volatile and speculative of all the markets made the contrast in March all the more remarkable. Industrial demand was fairly good, but if the "bull" group had not continued its supporting tactics, albeit unostentatiously, values would probably have given way, as the statistical position was by no means brilliant and does not look like improving very much in the immediate future, unless consumption unexpectedly expands very materially.

Average price of Cash Standard Tin: March, 1929, £220 17s. 4½d.; February, 1929, £223 4s. 8d.; March, 1928, £232 16s. 5d.; February, 1928, £233 18s. 10d.

LEAD.—This market was fairly steady till about the middle of the past month, when speculative activity, accompanied by scenes of panic rarely equalled on 'Change, rushed prices up more than £5 10s. on a single day. Subsequently, as was to be anticipated in view of the fact that the intrinsic position of the metal had not undergone any basic alteration, values slipped gradually down again, but nevertheless closed the month about £2 10s. higher than the level at which they had opened. Some emphasis has been laid recently on the Mexican revolt, which might have been expected to have held up supplies of ore and metal from that country, but the Government there seems to be rapidly getting the upper hand. With shipments from other countries likely to be well maintained, there would appear to have been little, if any, justification for the panic which recently seized the market.

Average mean price of soft foreign lead: March, 1929, £25 9s. 11d.; February, 1929, £23 2s. 10d.; March, 1928, £20 2s. 10d.; February, 1928, £20 10s. 3d.

SPELTER.—This market, which earlier in the month had already displayed signs of strength, owing mainly to the optimistic utterances of the members of the International Zinc Cartel at their latest meeting, joined in the panic movement which also affected copper and lead on March 18, and prices shot up a further £2 that day, only to recede again towards the close of the month. On balance, however, values gained fully 20s. during March. Producers have decided to reduce their output-curtailment figure from 10 to 7%, expressing themselves as very satisfied with the results their action has so far achieved. As industrial demand is rather subdued, however, their satisfaction may prove rather premature, although admittedly stocks in America and Europe have been reduced latterly.

Average mean price of spelter: March, 1929, £27 3s. 5d.; February, 1929, £26 5s. 11d.; March, 1928, £25 0s. 5d.; February, 1928, £25 10s. 2d.

IRON AND STEEL.—Conditions continued cheerful during March. No. 3 foundry was quoted for early delivery at 67s., but 68s. 6d. was asked for deliveries over the second half of the year. Hematite was firm and scarce, with East Coast Mixed Nos. priced at 74s.

IRON ORE.—This market has worn a firm appearance recently and for early delivery there is now not a great deal available. Prices are somewhat nominal, with best Bilbao rubio about 23s. to 23s. 6d. per ton c.i.f.

ANTIMONY.—At the close of the month English regulus was still quoted at £54 to £55 per ton, though less was accepted for good lines. Chinese material was firm, owing to the strength of other metals, and spot was quoted around £38 5s., ex warehouse, whilst for shipment from the East the value was about £35 15s. c.i.f.

ARSENIC.—A steady tone continues here, with prices about £16 to £16 5s. per ton f.o.r. mines for high grade Cornish white.

BISMUTH.—Quite a good business is passing at the unchanged official price of 7s. 6d. per lb. for merchant quantities.

CADMIUM.—A fairly brisk inquiry has developed again recently, and sellers are firmly holding for about 4s. to 4s. 2d. per lb., according to quantity and delivery.

COBALT METAL.—Business in this metal has improved recently, and a very fair turnover is reported. The official price of 10s. per lb., however, is only obtained for small parcels.

COBALT OXIDES.—A steady demand is maintained from the potteries and prices are without change at 8s. per lb. for black and 8s. 10d. for grey.

PLATINUM.—During the early part of March a very good business was done and, although latterly the volume of demand has been rather smaller, the market wears quite a sound appearance. Refined metal is officially priced at £13 17s. 6d. per oz., but this figure is shaded somewhat for merchant quantities.

PALLADIUM.—A steady if somewhat moderate demand is maintained, prices ranging from £9 10s. to £10 10s. per oz.

IRIDIUM.—There is no change to report in this market, sponge and powder remaining at £57 to £60 per oz.

SELENIUM.—A very fair business continued to take place in high grade black powder at 7s. 8d. to 7s. 9d. per lb. ex warehouse.

TELLURIUM.—Hardly any interest is shown in this metal and quotations can only be considered nominal at about 12s. 6d. to 15s. per lb.

LONDON DAILY METAL PRICES

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

	COPPER.												TIN.				ZINC (Spelter).			
	Standard.				Electrolytic				Wire Bars			Best Selected.								
	Cash.			3 Months.			Near.			Forward.			Near.			Forward.								
Mar.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
11	82	0	0	83	7	6	91	0	0	91	10	0	91	10	0	—			—			220	5	0	221	2	6	26	3	9	26	13	9
12	81	16	3	83	2	6	91	0	0	91	10	0	91	10	0	87	10	0	88	15	0	218	7	6	219	2	6	26	7	6	26	15	0
13	85	5	0	86	12	6	93	10	0	94	0	0	94	0	0	—			—			219	15	0	219	17	6	26	12	6	26	18	9
14	87	12	6	89	0	0	93	10	0	94	0	0	94	0	0	—			—			220	17	6	220	7	6	26	12	6	26	18	9
15	90	7	6	91	15	0	95	10	0	96	10	0	96	10	0	93	10	0	94	15	0	221	15	0	221	5	0	26	17	6	27	2	6
18	95	12	6	96	0	0	98	10	0	99	10	0	99	10	0	—			—			224	15	0	224	15	0	26	17	6	27	2	6
19	95	5	0	96	10	0	102	10	0	103	10	0	103	10	0	100	0	0	101	5	0	224	5	0	225	0	0	27	18	9	28	1	3
20	95	10	0	96	15	0	102	10	0	103	10	0	103	10	0	—			—			221	10	0	222	15	0	28	0	0	28	5	0
21	97	5	0	98	12	6	107	10	0	108	10	0	108	10	0	—			—			224	0	0	224	0	0	28	7	6	28	15	0
22	97	0	0	98	7	6	107	10	0	108	10	0	108	10	0	106	0	0	107	5	0	223	5	0	223	0	0	27	13	9	28	0	0
25	95	7	6	96	12	6	111	12	6	112	12	6	112	12	6	—			—			221	5	0	221	15	0	27	8	9	27	12	6
26	95	6	3	96	13	9	112	0	0	112	10	0	112	10	0	105	0	0	106	5	0	220	2	6	220	17	6	27	7	6	27	6	3
27	93	18	9	95	6	3	109	0	0	111	10	0	111	10	0	—			—			220	17	6	221	18	9	27	11	3	27	8	9
28	94	2	6	95	8	9	110	0	0	111	0	0	111	0	0	100	0	0	101	5	0	220	6	3	221	11	3	27	10	0	27	10	0
April																																	
2	95	18	9	96	7	6	110	0	0	111	0	0	111	0	0	100	0	0	101	5	0	219	13	9	220	11	3	27	12	6	27	12	6
3	95	17	6	96	1	3	108	0	0	110	0	0	110	0	0	—			—			219	13	9	220	13	9	27	15	0	27	12	6
4	89	12	6	89	16	3	104	0	0	108	0	0	108	0	0	—			—			218	7	6	218	7	6	26	15	0	26	15	0
5	87	18	9	87	2	6	104	0	0	107	0	0	107	0	0	—			—			217	12	6	217	7	6	26	17	6	26	15	0
8	87	2	6	86	7	6	104	0	0	107	0	0	107	0	0	—			—			214	12	6	214	12	6	26	17	0	26	15	0
9	80	12	6	79	12	6	90	0	0	100	0	0	100	0	0	85	0	0	86	5	0	209	17	6	209	17	6	26	12	6	26	8	9

Manganese Ore.—A rather steadier appearance has developed in this market lately, as less selling pressure has been in evidence from Russia. Prices, however, have not altered materially, and best Indian stands at about 1s. 2d. to 1s. 2½d. per unit c.i.f. while washed Caucasian ore might be called about 1s. 1¾d. per unit c.i.f. For 48 per cent Indian about 1s. 1d. to 1s. 1½d. is named.

Aluminium.—This metal has benefited from the advance in copper prices and a fairly brisk demand has developed. There is now some talk of prices being advanced. For the present, however, £95 per ton, less 2%, remains the current quotation.

Sulphate of Copper.—Prices are naturally much firmer, in view of the advance in copper, and English material is now held for about £35 10s. to £36 per ton, less 5%.

Nickel.—A steady business is maintained at the unaltered prices of £170 to £175 per ton, according to quantity.

Chrome Ore.—Quite a large turnover is reported, with quotations unaltered at about £4 5s. to £4 7s. 6d. per ton c.i.f. for 48% Rhodesian, with Indian and New Caledonian of similar grade slightly dearer.

Quicksilver.—The interest shown in this commodity has remained somewhat meagre, but prices are unchanged at £22 2s. 6d. to £22 5s. per bottle for spot material.

Tungsten Ore.—Almost unprecedented conditions have developed in this market owing to the very heavy demand which has been in evidence from America, where considerable stocks have been accumulated against the possibility of an increase in the import duty. There is now practically nothing to be had for shipment during the first half of the year, and prices are largely nominal at about 24s. per unit c.i.f.

Molybdenum Ore.—A rather firmer tone has developed here, although the volume of business passing has not been unduly large. Current quotations are about 34s. 6d. to 35s. per unit c.i.f.

	LEAD.									SILVER.		GOLD	
	Soft Foreign.						English.			Cash.	Forward.		
	Near.			Forward.									
	£	s.	d.	£	s.	d.	£	s.	d.	d.	d.	s.	d.	Mar.
	23	12	6	23	16	3	25	0	0	25 15/16	25 15/16	84	11½	11
	23	5	0	23	11	3	24	15	0	26	26	84	10½	12
	23	11	3	23	17	6	25	0	0	26	26 1/16	84	11½	13
	23	13	9	23	18	9	25	0	0	26	26 1/16	84	11½	14
	24	1	3	24	6	3	25	0	0	26	26 1/16	84	11½	15
	26	15	0	27	0	0	31	10	0	26	26	84	11½	18
	27	17	6	28	2	6	29	0	0	25 7/16	25 15/16	84	10½	19
	27	10	0	27	15	0	29	10	0	25 15/16	26	84	10½	20
	28	12	6	28	17	6	30	0	0	26 1/16	26 1/8	84	11	21
	28	17	6	29	0	0	30	0	0	26 1/8	26 1/4	84	11¼	22
	27	2	6	27	2	6	28	10	0	26	26 1/16	84	11½	25
	26	7	6	26	6	3	28	0	0	26 1/16	26 1/8	84	11½	26
	26	5	0	26	5	0	27	15	0	26 1/16	26 1/8	84	11½	27
	26	6	3	26	6	3	27	16	3	25 15/16	26	84	11¾	28
														April
	26	12	6	26	12	6	27	15	0	25 15/16	26	84	11½	2
	26	13	9	26	13	9	27	15	0	25 7/8	25 7/8	84	10¼	3
	24	12	6	24	12	6	27	5	0	25 5/8	25 7/8	84	11	4
	25	0	0	24	15	0	27	0	0	25 3/4	25 7/8	84	11¼	5
	25	2	6	25	0	0	26	5	0	25 13/16	25 15/16	84	11⅛	8
	24	10	0	24	1	3	26	0	0	25 7/8	25 7/8	84	10¼	9

Graphite.—Quite a good business has been done recently and prices are if anything a shade firmer. Madagascar 85 to 90% flake might be called about £27 to £29 per ton c.i.f. and 90% Ceylon lumps around £25 to £26.

Silver.—At the beginning of March the market was quiet, but fairly steady, spot bars standing at 26d. on March 1. The trouble in Mexico and the possibility of renewed disturbances in China were considered favourable factors, but prices did not improve, and on 15th ult. spot bars closed at 26d. per oz., having fallen slightly below that figure previously. In the latter part of the month both India and China showed some buying interest, but this was confined to impracticably low bids and quotations showed little movement throughout the month, spot bars closing at 25 15/16d. on March 28.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
March, 1928	840,837	36,543	877,380
April	789,823	36,084	825,907
May	849,155	37,031	886,186
June	825,143	37,220	862,363
July	828,482	38,729	867,211
August	854,172	37,691	891,863
September	819,341	38,390	857,731
October	858,945	38,775	897,720
November	832,461	40,023	872,484
December	821,582	38,179	859,761
January, 1929	840,344	36,108	876,452
February	778,559	36,725	815,284
March	840,837	36,543	877,380

TRANSVAAL GOLD OUTPUTS.

	February.		March.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	80,800	£131,315	91,500	£148,025
City Deep	83,000	22,033	87,000	24,126
Cons. Main Reef	53,000	20,759	58,300	22,246
Crown Mines	195,000	65,497	210,000	70,540
D'rb'n Roodepoort Deep	35,300	12,598	39,000	13,555
East Rand P.M.	132,000	35,162	142,500	37,430
Ferreira Deep	30,400	4,921	26,500	4,820
Geduld	79,500	24,978	85,000	26,588
Geldenhuis Deep	55,000	13,302	53,400	14,375
Glynn's Lydenburg	5,200	1,635	6,100	2,206
Government G.M. Areas	187,000	£363,220	196,000	£373,760
Kleinfontein	48,400	10,845	52,200	11,540
Langlaagte Estate	76,000	£104,161	79,000	£110,287
Luipaard's Vlei	21,200	5,421	22,500	5,682
Meyer and Charlton	16,200	£18,329	17,300	£18,650
Modderfontein New	133,000	68,386	144,000	73,842
Modderfontein B	64,000	24,559	69,000	25,739
Modderfontein Deep	41,800	22,117	43,000	22,727
Modderfontein East	61,000	19,072	63,500	19,865
New State Areas	71,000	£129,184	75,000	£134,896
Nourse	57,000	16,327	62,000	18,046
Randfontein	191,000	£189,123	212,000	£200,872
Robinson Deep	67,000	19,844	75,000	22,182
Rose Deep	50,300	10,722	56,000	11,915
Sabie	3,220	793	—	—
Simmer and Jack	67,500	17,236	76,500	18,745
Springs	64,000	£132,001	67,000	£138,193
Sub Nigel	23,400	21,197	23,400	20,769
Transvaal G.M. Estates	13,320	4,636	15,400	4,562
Van Ryn	37,000	£38,636	38,000	£39,857
Van Ryn Deep	60,000	£99,268	62,000	£104,674
Village Deep	55,000	14,468	58,000	14,994
West Rand Consolidated	77,000	£82,737	85,500	£93,495
West Springs	57,000	£72,694	60,000	£75,996
Witw'tersr'nd (Knights)	48,000	£42,809	52,000	£45,695
Witwatersrand Deep	41,500	9,429	45,000	9,839
Wolhuter	25,900	6,000	28,000	6,291

COST AND PROFIT ON THE RAND.

Compiled from official statistics published by the Transvaal Chamber of Mines.

	Tons milled.	Yield per ton.	Work'g cost per ton.	Work'g profit per ton.	Total working profit.
		s. d.	s. d.	s. d.	£
January, 1928	2,428,600	28 2	19 9	8 5	1,021,891
February	2,357,900	28 1	19 11	8 2	959,824
March	2,552,100	27 11	19 9	8 2	1,039,078
April	2,381,800	28 2	20 0	8 2	971,128
May	2,571,900	28 0	19 7	8 5	1,084,465
June	2,500,100	28 2	19 10	8 4	1,038,851
July	2,528,600	27 11	19 8	8 3	1,048,432
August	2,580,700	27 11	19 7	8 4	1,079,152
September	2,485,700	27 11	19 7	8 4	1,040,368
October	2,612,500	27 9	19 5	8 4	1,092,162
November	2,539,700	27 9	19 7	8 2	1,041,713
December	2,505,500	27 10	19 8	8 2	1,024,654
January, 1929	2,627,320	28 1	19 9	8 4	1,095,070
February	—	—	—	—	990,942

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
March 31, 1928	199,487	16,720	5,167	214,950
April 30	199,820	16,696	5,664	219,700
May 31	198,461	16,943	5,742	222,172
June 30	197,186	16,870	5,650	222,340
July 31	194,584	16,695	5,189	220,345
August 31	194,788	16,553	4,839	218,578
September 30	194,936	16,724	4,535	215,843
October 31	193,147	16,767	4,807	216,362
November 30	190,970	16,803	4,889	216,628
December 31	187,970	16,059	4,444	208,473
January 31, 1929	192,526	15,845	50,56	213,427
February 28	196,150	15,940	5,635	217,725
March 30	197,646	16,065	5,787	219,498

PRODUCTION OF GOLD IN RHODESIA.

	1926	1927	1928	1929
	oz.	oz.	oz.	oz.
January	48,967	48,731	51,356	46,231
February	46,026	46,461	46,286	44,551
March	46,902	50,407	48,017	—
April	51,928	48,290	48,549	—
May	49,392	48,992	47,323	—
June	52,381	52,910	51,762	—
July	50,460	49,116	48,960	—
August	49,735	47,288	50,611	—
September	48,350	45,838	47,716	—
October	50,132	46,752	43,056	—
November	51,090	47,435	47,705	—
December	48,063	49,208	44,77	—

RHODESIAN GOLD OUTPUTS.

	February.		March.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	22,000	11,276	24,000	12,030
Globe and Phœnix	6,005	5,119	6,005	4,778
Lonely Reef	5,060	4,066	5,200	4,106
Rezende	6,000	2,911	6,400	2,980
Shamva	43,900	£23,874	—	—
Sherwood Starr	4,600	£7,640	4,800	£8,398

WEST AFRICAN GOLD OUTPUTS.

	February.		March.	
	Tons.	Oz.	Tons.	Oz.
Ashanti Goldfields	8,500	9,061	9,214	9,876
Taquah and Abosso	9,680	£13,287	9,460	£13,353

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.	New South Wales.
	Oz.	Oz.	Oz.	Oz.
March, 1928	23,603	2,098	1,339	4,176
April	36,487	2,811	846	318
May	29,264	2,990	321	397
June	39,449	3,932	498	487
July	29,399	3,208	772	154
August	37,991	2,637	600	3,447
September	32,397	3,366	644	364
October	36,565	2,632	820	256
November	31,466	3,111	865	—
December	36,097	—	—	208
January, 1929	27,384	—	—	—
February	28,177	—	—	—
March	25,848	—	—	—

AUSTRALASIAN GOLD OUTPUTS.

	February.		March.	
	Tons	Value £	Tons	Value £
Associated G.M. (W.A.)	4,885	7,160	5,201	9,130
Blackwater (N.Z.)	3,400	5,826	3,274	4,504
Boulder Persev'ce (W.A.)	5,869	15,927	4,448	14,788
Grt. Boulder Pro. (W.A.)	8,959	25,385	10,332	27,326
Lake View & Star (W.A.)	7,766	11,615	—	—
Sons of Gwalia (W.A.)	13,294	10,596	15,054	11,208
South Kalgurli (W.A.)	8,167	15,038	—	—
Waihi (N.Z.)	17,203	5,342* / 43,853†	—	—

* Oz. gold. † Oz. silver.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	February.		March.	
	Tons Ore	Total Oz.	Tons Ore	Total Oz.
Balaghat	3,700	2,356	4,450	2,734
Champion Reef	8,650	5,214	8,865	5,269
Mysore	15,660	8,022	17,125	8,318
Nundydroog	10,300	6,502	11,010	6,663
Ooregum	13,500	7,212	14,000	7,446

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	February.		March.	
	Tons	Value £	Tons	Value £
Chosen Synd. (Korea)	6,585	9,920	7,760	12,105
Frontino & Bolivia (C'lbia)	1,900	6,319	1,900	7,570
Gabait (Sudan)	490	935	—	—
La Noria (Mexico)	—	115,400*d*	—	—
Lampa (Bolivia)	31,000*s*	—	—	—
Lena (Siberia)	—	15,195*	—	20,757
Lydenburg Plat. (Trans.)	3,235	607*p*	3,360	642*p*
Marmajito (Colombia)	540	3,019	520	4,196
Mexican Corp. Fresnillo	84,383	120,759*d*	—	—
Onverwacht Platinum	2,220	475*p*	2,317	463*p*
Oriental Cons. (Korea)	—	69,000*d*	—	32,500*d*
St. John del Rey (Brazil)	—	29,000	—	32,300
Santa Gertrudis (Mexico)	46,407	122,211*e*	—	—

d dollars. *p* Oz. platinoids. *s* Oz. silver.
e Profit in dollars.
* From February 16 to February 28.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

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

July, 1928	5,488	January, 1929	5,840
August	5,499	February	4,896
September	5,071	March	5,236
October	5,161	April	—
November	5,483	May	—
December	5,249	June	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	Jan.	Feb.	Mar.
Ampang	14	15½	14
Changkat	—	60	—
Chenderiang	24	20	29
Gopeng	80½	77½	80½
Idris Hydraulic	35½	35⅝	41⅝
Ipoh	49⅝	43½	51
Jelapang	—	21	—
Kamunting	71	63	93
Kent (F.M.S.)	54	51	57
Kepong	25⅝	18	25
Kinta	30½	30	27
Kinta Kellas	23⅝	25	41½
Kramat Pulai	25½	22½	20⅝
Kuala Kampar	142	130	—
Kundang	—	32	—
Lahat	21	19½	18½
Larut Tinfields	—	70	—
Malaya Consolidated	70½	66½	54⅜
Malayan Tin	172½	154⅜	160⅝
Meru	20	17½	16½
Pahang	206	208	222½
Pattani	3½	4½	—
Pengkalen	51	51	65½
Petaling	190	220	238
Rahman	59½	56½	53½
Rambutan	15	12	12
Rantau	60	55	50
Rawang	—	65	—
Renong	60⅜	50⅜	48½
Selayang	18	12½	22
Southern Malayan	104½	95½	113
Southern Perak	50½	47	66⅜
Sungei Besi	46	43	46
Sungei Kinta	38⅜	33⅜	31
Sungei Way	44½	47½	62½
Taiping	41	41	48
Tanjong	22½	24	24
Teja Malaya	13⅜	6	16
Tekka	50½	50½	50½
Tekka-Taiping	51	45	54
Temoh	17	15⅜	22
Tronoh	[illegible]	109?	111

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	January.	February.	March.
Amari	—	4⅜	—
Anglo-Nigerian	60	60	57
Associated Tin Mines	245	237	—
Baba River	5½	4⅛	3½
Batura Monguna	4½	3	4
Bisichi	53	56	58
Daffo	6	5	5
Ex-Lands	50	50	50
Filani	2	1½	1½
Jantar	40	35	25
Jos	19	17	19¾
Juga Valley	11	11	—
Junction	20	20	—
Kaduna	41½	30½	—
Kaduna Prospectors	26½	18	—
Kassa	17	11	16
Lower Bisichi	5¼	4	5
Mongu	35	35	—
Naraguta	30	16	—
Naraguta Durumi	—	9	9
Naraguta Extended	10	10	9
Naraguta Karama	30½	18½	16½
Naraguta Korot	—	15	15
Nigerian Base Metals	62⅞	47	—
Nigerian Consolidated	20	20	20
N.N. Bauchi	150	150	—
Offin River	12½	12	6½
Ribon Valley	18½	18	17
Ropp	80	81	72
Rukuba	4	4	4
South Bukeru	10	12½	15
Tin Fields	7	6⅝	7⅜
Tin Properties	24	27	—
United Tin Areas	7½	4½	5½
Yarde Kerri	10	15	—

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Jan.	Feb.	March
Anglo-Burma (Burma)	11	6	6
Aramayo Mines (Bolivia)	253	251	329
Bangrin (Siam)	44⅜	41½	52⅜
Berenguela (Bolivia)	33	27	—
Briseis (Tasmania)	20	26	—
C'nsolidated Tin Mines (Burma)	94*	87*	91*
Eastern Siam (Siam)	11	3½	4½
East Pool (Cornwall)	83	84	—
Fabulosa (Bolivia)	168	145	154
Geevor (Cornwall)	68	68	73
Jantar (Cornwall)	29†	13⅜	—
Kagera (Uganda)	23	23	25
San Finx (Spain)	36½*	27*	—
Siamese Tin (Siam)	120½	98	139½
South Crofty (Cornwall)	66½	61½	66
Tavoy Tin (Burma)	50	44½	—
Theindaw (Burma)	5	4½	—
Tongkah Harbour (Siam)	87	86	110
Toyo (Japan)	41	43	—
Wheal Kitty (Cornwall)	42	55	—

* Tin and Wolfram. † Two months.

COPPER, LEAD, AND ZINC OUTPUTS.

		Feb.	Mar.
Broken Hill Prop.	Tons lead conc.	—	1,298
Broken Hill South	Tons lead conc.	4,966	—
	Tons zinc conc.	4,769	—
Burma Corporation	Tons refined lead	6,506	6,602
	Oz. refined silver	618,141	628,211
Bwana M'Kubwa	Tons copper oxide	676	767
Electrolytic Zinc	Tons zinc	3,909	—
Indian Copper	Tons copper	—	78½
Messina	Tons copper	448	539
Mount Lyell	Tons concentrates	2,289	2,639
Namaqua	Tons copper	136	—
North Broken Hill	Tons lead conc.	7,200	—
	Tons zinc conc.	5,410	—
Poderosa	Tons copper ore	804	912
Rhodesia Broken Hill	Tons lead	355	345
	Tons slab zinc	822	1,007
San Francisco Mexico	Tons lead conc.	3,020	—
	Tons zinc conc.	3,606	—
Sulphide Corporation	Tons lead conc.	2,030*	—
	Tons zinc conc.	3,024*	—
Tetiuhe	Tons lead conc.	586	586
	Tons zinc conc.	1,079	1,628
Union Minière	Tons copper	8,600	—
Zinc Corporation	Tons lead conc.	5,084	—
	Tons zinc conc.	4,762	—

* Four weeks to February 23.

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

		January.	February.
Iron Ore	Tons	487,871	313,475
Manganese Ore	Tons	17,099	16,178
Iron and Steel	Tons	244,267	160,035
Copper and Iron Pyrites	Tons	32,465	29,522
Copper Ore, Matte, and Prec.	Tons	4,786	5,494
Copper Metal	Tons	15,844	9,888
Tin Concentrate	Tons	7,036	6,617
Tin Metal	Tons	974	1,051
Lead Pig and Sheet	Tons	28,090	19,246
Zinc (Spelter)	Tons	13,101	9,078
Zinc Sheets, etc.	Tons	2,922	1,755
Aluminium	Tons	701	1,627
Quicksilver	Lb.	23,350	—
Zinc Oxide	Tons	1,248	896
White Lead	Cwt.	11,791	12,150
Red and Orange Lead	Cwt.	3,907	3,282
Barytes, ground	Cwt.	76,353	38,967
Asbestos	Tons	3,593	1,889
Boron Minerals	Tons	—	1,005
Borax	Cwt.	7,801	5,467
Basic Slag	Tons	8,797	4,529
Superphosphates	Tons	13,767	18,856
Phosphate of Lime	Tons	61,920	25,579
Mica	Tons	288	216
Sulphur	Tons	10,899	10,507
Nitrate of Soda	Cwt.	297,116	286,630
Potash Salts	Cwt.	359,114	300,762
Petroleum : Crude	Gallons	36,557,082	28,689,716
Lamp Oil	Gallons	23,095,885	16,350,638
Motor Spirit	Gallons	45,044,560	70,407,029
Lubricating Oil	Gallons	8,052,856	7,685,750
Gas Oil	Gallons	14,878,871	5,804,516
Fuel Oil	Gallons	45,345,587	21,664,246
Asphalt and Bitumen	Tons	15,299	18,982
Paraffin Wax	Cwt.	135,541	104,146
Turpentine	Cwt.	20,941	18,353

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES.

In Tons.

	Jan.	Feb.	March
Anglo-Ecuadorian	13,106	12,024	13,968
Anglo-Egyptian	19,560	—	—
Apex Trinidad	32,640	31,880	37,210
Attock	9,430	7,135	6,457
British Burmah	5,700	5,016	5,440
British Controlled	30,426	31,528	—
Kern Mex	1,044	860	—
Kern River (Cal.)	5,699	3,226	—
Kern Romana	3,906	3,572	—
Kern Trinidad	4,548	3,733	—
Lobitos	26,901	25,268	27,629
Mexican Eagle	78,001	—	—
Phœnix	33,484	32,516	41,007
St. Helen's Petroleum	5,218	11,214	—
Steaua Romana	60,670	50,390	63,100
Trinidad Leaseholds	34,200	28,800	32,300
United of Trinidad	5,872	—	—
Venezuelan Consolidated	—	—	2,143

QUOTATIONS OF OIL COMPANIES SHARES.

Denomination of Shares £1 unless otherwise noted.

	Mar. 7, 1929	April 8, 1929
	£ s. d.	£ s. d.
Anglo-American	3 12 6	3 10 0
Anglo-Ecuadorian	1 2 0	1 2 0
Anglo-Egyptian B	2 15 0	2 17 0
Anglo-Persian 1st Pref.	1 7 0	1 7 0
" Ord.	4 8 9	4 11 0
Apex Trinidad (5s.)	1 6 3	1 7 0
Attock	3 0 0	3 3 6
British Burmah (8s.)	7 0	7 0
British Controlled ($5)	5 0	5 6
Burmah Oil	4 7 6	4 8 9
Kern River, Cal. (10s.)	8 6	8 0
Lobitos, Peru	2 1 3	2 3 6
Mexican Eagle, Ord. (4 pesos)	12 9	13 4
" " 8% Pref. (4 pesos)	12 0	12 6
Phœnix, Roumania	13 0	14 0
Royal Dutch (1,000 fl.)	32 10 0	33 0 0
Shell Transport, Ord.	4 12 6	4 17 0
" 5% Pref. (£10)	9 18 9	10 0 0
Steaua Romana	11 3	12 6
Trinidad Leaseholds	4 6 3	4 13 6
United British of Trinidad (6s. 8d.)	9 6	10 3
V.O.C. Holding	4 9 6	4 1 0

PRICES OF CHEMICALS. April 8.

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

		£ s. d.
Acetic Acid, 40%	per cwt.	16 6
" 80%	"	1 16 0
" Glacial	per ton	66 0 0
Alum	"	8 10 0
Alumina, Sulphate, 17 to 18%	"	6 15 0
Ammonia, Anhydrous	per lb.	10
" 0·880 solution	per ton	19 0 0
" Carbonate	"	27 10 0
" Nitrate	"	24 0 0
" Phosphate	"	40 0 0
" Sulphate, 20·6% N.	"	10 13 0
Antimony, Tartar Emetic	per lb.	1 1
" Sulphide, Golden	"	7
Arsenic, White	per ton	16 5 0
Barium Carbonate, 92%	"	5 10 0
" Chlorate	per lb.	4½
" Chloride	per ton	10 15 0
" Sulphate, 94%	"	6 0 0
Benzol, standard motor	per gal.	1 10½
Bleaching Powder, 35% Cl.	per ton	7 0 0
" Liquor, 7%	"	3 5 0
Borax	"	20 0 0
Boric Acid	"	30 0 0
Calcium Chloride	"	4 12 6
Carbolic Acid, crude 60%	per gal	1 11
" " crystallized, 40°	per lb.	6½
Carbon Disulphide	per ton	24 0 0
Citric Acid	per lb.	2 2
Copper Sulphate	per ton	31 10 0
Cyanide of Sodium, 100% KCN	per lb.	2
Hydrofluoric Acid	"	6
Iodine	per oz.	1 0
Iron, Nitrate	per ton	6 10 0
" Sulphate	"	1 17 6
Lead, Acetate, white	"	43 5 0
" Nitrate	"	34 0 0
" Oxide, Litharge	"	35 0 0
" White	"	43 5 0
Lime, Acetate, brown	"	8 10 0
" " grey, 80%	"	17 0 0
Magnesite, Calcined	"	8 0 0
Magnesium, Chloride	"	6 15 0
" Sulphate	"	3 2 6
Methylated Spirit 64° Industrial	per gal.	1 5
Nitric Acid, 80° Tw.	per ton	21 0 0
Oxalic Acid	per lb.	3
Phosphoric Acid	per ton	29 15 0
Potassium Bichromate	per lb.	4½
" Carbonate	per ton	26 2 6
" Chlorate	per lb.	3
" Chloride 80%	per ton	9 0 0
" Hydrate (Caustic) 90%	"	33 5 0
" Nitrate, refined	"	20 10 0
" Permanganate	per lb.	5½
" Prussiate, Yellow	"	6½
" Red	"	1 9
" Sulphate, 90%	per ton	11 5 0
Sodium Acetate	per ton	20 15 0
" Arsenate, 45%	"	26 0 0
" Bicarbonate	"	10 10 0
" Bichromate	per lb.	3½
" Carbonate (Soda Ash)	per ton	6 5 0
" " (Crystals)	"	5 5 0
" Chlorate	per lb.	2¾
" Hydrate, 76%	per ton	14 10 0
" Hyposulphite	"	9 0 0
" Nitrate, 96%	"	10 12 0
" Phosphate	"	11 10 0
" Prussiate	per lb.	4½
" Silicate	per ton	9 10 0
" Sulphate (Salt-cake)	"	2 10 0
" " (Glauber's Salt)	"	2 5 0
" Sulphide	"	9 0 0
Sulphur, Roll	"	10 0 0
" Flowers	"	11 10 0
Sulphuric Acid, 168°	"	6 5 0
" " free from Arsenic, 144°	"	4 0 0
Superphosphate of Lime, 35%	"	3 0 0
Tartaric Acid	per lb.	1 4½
Turpentine	per cwt.	2 7 3
Tin Crystals	per lb.	1 6½
Titanous Chloride	"	10
Zinc Chloride	per ton	12 0 0
Zinc Dust	"	35 0 0
Zinc Oxide	"	42 0 0
Zinc Sulphate	"	10 5 0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

GOLD AND SILVER:	Mar. 7, 1929. £ s. d.	April 8, 1929. £ s. d.
SOUTH AFRICA:		
Brakpan	4 8 9	4 6 0
City Deep	11 3	13 0
Consolidated Main Reef	15 9	18 0
Crown Mines (10s.)	3 2 6	3 2 6
Daggafontein	1 1 3	1 2 6
Durban Roodepoort Deep	11 3	9 6
East Geduld	1 18 9	2 2 6
East Rand Proprietary (10s.)	11 9	11 3
Ferreira Deep	6 9	6 3
Geduld	3 12 6	3 12 0
Geldenhuis Deep	4 3	4 6
Glynn's Lydenburg	5 0	5 0
Government Gold Mining Areas (5s.)	1 19 3	1 19 3
Kleinfontein	2 9	2 6
Langlaagte Estate	1 1 0	1 0 6
Luipaards Vlei (4s.)	4 6	4 6
Meyer & Charlton	9 3	9 0
Modderfontein New (10s.)	5 5 0	5 4 6
Modderfontein B (5s.)	17 0	17 0
Modderfontein Deep (5s.)	1 9 3	1 10 0
Modderfontein East	1 5 3	1 4 6
New State Areas	1 11 9	1 11 6
Nourse	8 0	8 3
Randfontein	6 9	6 3
Robinson Deep A (1s.)	13 9	14 0
" " B	12 6	11 0
Rose Deep	6 3	6 0
Simmer & Jack (2s. 6d.)	3 0	3 0
Springs	3 8 0	3 6 0
Sub Nigel (10s.)	1 13 3	1 13 0
Transvaal Gold Mining Estates	9 6	9 0
Van Ryn	11 0	9 0
Van Ryn Deep	2 0 9	1 19 0
Village Deep	3 6	4 0
West Rand Consolidated (10s.)	11 0	9 0
West Springs	18 9	18 6
Witwatersrand (Knight's)	8 0	7 0
Witwatersrand Deep	5 0	5 0
Wolhuter	1 0	1 0
RHODESIA:		
Cam and Motor	1 18 0	1 18 0
Gaika	6 3	8 0
Globe and Phœnix (5s.)	10 9	10 9
Lonely Reef	1 7 6	1 3 0
Rezende	18 0	19 0
Shamva	9 3	7 0
Sherwood Starr	9 3	11 6
GOLD COAST:		
Ashanti (4s.)	1 1 3	1 4 3
Taquah and Abosso (5s.)	2 3	2 3
AUSTRALASIA:		
Associated Gold Mines (4s.), W.A.	1 3	1 3
Blackwater, N.Z.	2 6	2 6
Boulder Perseverance (1s.), W.A.	1 0	9
Great Boulder Proprietary (2s.), W.A	2 6	2 6
Lake View and Star (4s.), W.A.	12 0	11 0
Sons of Gwalia, W.A.	3 3	3 3
South Kalgurli (10s.), W.A.	16 9	16 9
Waihi (5s.), N.Z.	14 6	13 9
Waihi Grand Junction, N.Z.	1 0	1 0
Wiluna Gold, W.A.	1 3 6	1 3 0
INDIA:		
Balaghat (10s.)	6 0	6 0
Champion Reef (10s)	10 0	10 3
Mysore (10s.)	16 6	15 6
Nundydroog (10s.)	18 9	18 6
Ooregum (10s.)	13 0	12 0
AMERICA:		
Camp Bird (2s.), Colorado	2 9	2 9
Chosen (Korea)	17 6	18 6
Frontino and Bolivia, Colombia	8 9	8 9
Keeley Silver ($1.00), Ontario	2 0	2 0
Mexican Corporation, Mexico	10 0	12 6
Mexico Mines of El Oro, Mexico	10 0	6 6
Oroville Dredging, Colombia (4s.)	2 9	2 9
Panama Corporation	12 6	12 6
St. John del Rey, Brazil	16 0	15 9
Santa Gertrudis, Mexico	10 0	10 0
Selukwe (2s. 6d.), British Columbia	7 0	7 3
Vipond ($1), Ontario	5 0	4 3
RUSSIA:		
Lena Goldfields	4 6	4 3

DIAMONDS:	Mar. 7, 1929. £ s. d.	April 8, 1929. £ s. d.
Consol. African Selection Trust (5s.)	1 7 0	1 8 9
Consolidated of S.W.A.	1 5 6	1 5 6
De Beers Deferred (£2 10s.)	14 1 3	14 6 0
Jagersfontein	2 14 6	2 11 6
Premier Preferred (5s.)	6 0 0	6 0 0
COPPER:		
Arizona Copper (5s.) Arizona	1 12 0	2 0 6
Bwana M'Kubwa (5s.) Rhodesia	1 0 3	1 0 6
Esperanza Copper, Spain	1 0 0	19 0
Messina (5s.), Transvaal	18 3	19 0
Mount Lyell, Tasmania	2 1 9	2 2 9
Namaqua (£2), Cape Province	1 2 6	1 7 0
N'Changa, Rhodesia	4 6 3	4 7 0
Rio Tinto (£5), Spain	62 0 0	60 7 6
Roan Antelope (5s.), Rhodesia	2 6 0	2 10 0
Tanganyika, Congo and Rhodesia	3 12 6	3 7 0
LEAD-ZINC:		
Broken Hill Proprietary N.S.W.	1 7 0	1 7 0
Broken Hill North, N.S.W.	5 1 3	5 12 0
Broken Hill South, N.S.W.	3 0 6	3 6 0
Burma Corporation (10 rupees)	17 0	17 3
Electrolytic Zinc Pref., Tasmania	1 15 0	1 15 0
Mount Isa, Queensland	2 1 0	2 8 0
Rhodesia Broken Hill (5s.)	4 0	4 6
Russo-Asiatic Consd. (2s. 6d.)	4 0	4 0
San Francisco (10s.), Mexico	1 15 0	1 16 0
Sulphide Corporation (15s.), N.S.W.	19 0	19 0
Tetiuhe (5s.), Siberia	5 0	5 0
Zinc Corporation (10s.), N.S.W.	2 9 0	2 10 0
TIN:		
Aramayo Mines (25 fr.), Bolivia	3 8 9	3 8 3
Associated Tin (5s.), Nigeria	12 0	11 6
Bangrin, Siam	2 0 0	1 16 6
Bisichi (10s.), Nigeria	10 3	10 0
Briseis, Tasmania	3 6	3 6
Chenderiang, Malay	11 0	11 0
Dolcoath (10s.), Cornwall	9	9
East Pool (5s.), Cornwall	1 9	1 9
Ex-Lands Nigeria (2s.), Nigeria	3 0	3 0
Fabulosa ($1.00), Bolivia	1 1	1 0
Geevor (10s.), Cornwall	9 0	8 6
Gopeng, Malaya	2 3 9	2 3 9
Idris (5s.), Malaya	16 0	15 9
Ipoh Dredging (16s.), Malay	1 8 9	1 8 0
Kamunting (5s.), Malay	16 9	15 9
Kinta, Malay	12 9	11 6
Lahat, Malay	14 3	14 0
Malayan Tin Dredging (5s.), Malay	1 8 0	1 6 0
Mongu (10s.), Nigeria	10 6	10 3
Naraguta, Nigeria	1 6 3	1 5 0
Nigerian Base Metals (5s.)	5 6	5 6
N.N. Bauchi, Nigeria (10s.)	1 2 6	1 2 6
Pahang Consolidated (5s.), Malay	11 6	10 6
Pengkalen (5s.), Malay	1 0 6	1 0 0
Petaling (2s. 4d.)	13 3	13 6
Renong Dredging, Malay	1 13 9	1 8 6
Ropp (4s.), Nigeria	8 6	8 6
Siamese Tin (5s.), Siam	18 0	16 3
South Crofty (5s.), Cornwall	5 6	4 9
Southern Malayan	14 6	13 3
Southern Perak, Malay	2 9 0	2 7 0
Southern Tronoh (5s.)	11 6	11 0
Sungei Besi (5s.), Malay	13 9	13 6
Tavoy (4s.), Burma	16 9	15 0
Tekka, Malay	19 9	1 0 0
Tekka Taiping, Malay	1 2 0	1 1 0
Toyo (10s.), Japan	11 6	11 0
Tronoh (5s.), Malay	1 0 6	1 0 9
FINANCE, ETC.:		
Anglo-American Corporation	2 6 0	2 2
Anglo-French Exploration	1 5 6	1 5 0
Anglo-Oriental (5s.)	19 3	19 6
British South Africa (15s.)	2 1 0	1 17 6
Central Mining (£8)	19 5 6	18 10 0
Chemical & Metallurgical Corp. (2s.)	4 0	4 0
Consolidated Gold Fields	2 18 9	2 17 0
Consolidated Mines Selection (10s.)	19 3	19 3
General Mining and Finance	1 3 0	19 0
Gold Fields Rhodesian (10s.)	11 4	10 9
Johannesburg Consolidated	2 8 9	2 7 6
London Tin Syndicate	4 0 0	3 13 6
Minerals Separation	5 3 6	6 17 6
National Mining (8s.)	4 3	4 6
Rand Mines (5s.)	3 4 6	3 2 0
Rhodesian Congo Border	5 15 0	7 18 6
Southern Rhodesia Base Metals	10 3	14 6
South-West Africa	16 0	16 0
Tin Selection Trust	1 6 3	1 5 3
Union Corporation (12s. 6d.)	4 10 0	4 10 9

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.

A GRAVITATIONAL SURVEY AT DRUMRY VALLEY, NEAR GLASGOW

In a paper before the Royal Society of Edinburgh on November 5, 1928, W. F. P. McLintock and J. Phemister describe the use of the Eotvos torsion balance in a survey of the buried valley of the River Kelvin at Drumry, about 7 miles west north west of Glasgow, which district afforded an example of moderate relief where terrain and topographic corrections might be of some magnitude. The only previous geophysical survey made by officers of H.M. Geological Survey in this country was on a plain, and was described in the MAGAZINE for December, 1927.

In the present survey 68 stations were determined visually during the night time between November, 1927 and March, 1928. Fig. 1 is a map from the Geological Survey Memoir on the Geology of the Glasgow District, showing the contours of the buried rock surface after removal of the superficial deposits in the district around Drumry. The contours are in feet referred to ordnance datum level, and, being based on a series of bores at considerable distances apart, are in some areas, particularly to the north and west of Drumry, conjectural. The deep channel north of Drumry

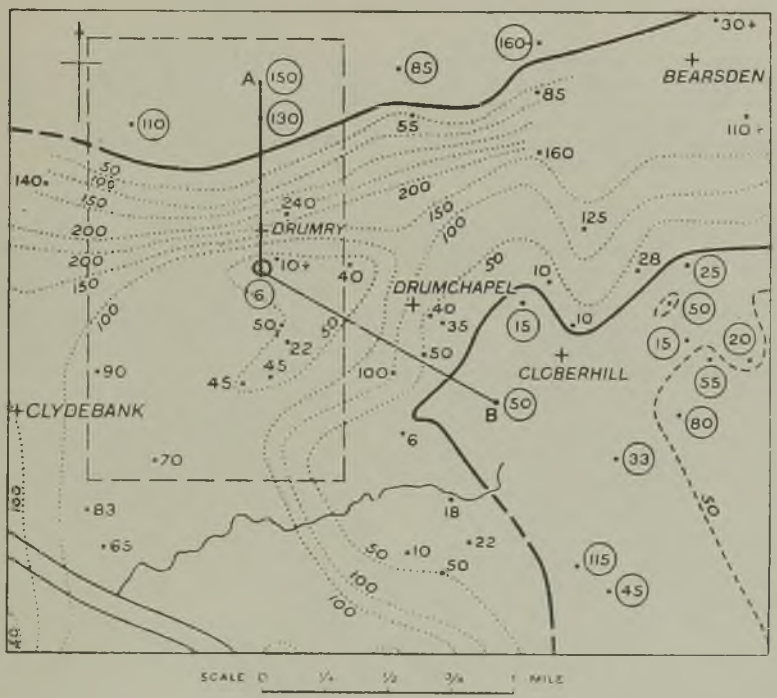


FIG. 1.—CONTOUR MAP OF THE ROCK SURFACE ROUND DRUMRY AFTER REMOVAL OF THE SUPERFICIAL DEPOSITS.

· (25), Height of rock surface in feet above Ordnance datum level.

· 25, Depth of rock surface in feet below Ordnance datum level.

· 25 +, Depth below Ordnance datum level, rock surface not reached.

Inset is the area shown in Fig. 3.

· (25–), Depth above Ordnance datum level, rock surface not reached.

– – – –, Contours in feet above Ordnance datum level.

. . . . . , Contours in feet below Ordnance datum level.

— — —, Ordnance datum (present mean sea-level).

and the steeply sloping mass of rock rising through the drift, but nowhere reaching the surface, to the south of that place are clearly shown. A section along the line AB of fig. 1 is given (fig. 2). The drift covering these ancient topographical features consists largely of clays and sands, with an average specific gravity of 1·72, whilst the subjacent rock consists of an alternating series of sandstones, shales, ironstones, and coals, belonging to the Coal and Ironstone Group of the Carboniferous Limestone Series. Determinations of the specific gravity of specimens of similar rocks from borings gave an average value of 2·38.

The objects of the survey were to delimit the mass of rock rising towards the surface near Drumry and to determine the gravitational results obtainable from a traverse across the buried channel to the north.

surface between rock and drift rises quickly from the east as a slope of 10° (=one in six), flattens for a short distance, and continues to rise westwards more gently as a slope of 2½° (=one in twenty-five). The calculated depth to rock at the point C (fig. 4) is 70 feet; the calculated depth to rock at bore I (fig. 4) is 80 feet; the depth to rock at that bore, as shown by the bore journal, is 74 feet.

To obtain theoretical gradient curves of the required shape entails no assumption as to the specific gravity difference between the less dense and more dense rocks. In order to obtain the numerical agreement shown in Fig. 5, it was necessary to assume a specific gravity difference of ·55 between rock and drift. Determinations of specific gravity of various types of Carboniferous rocks were made, and from the journal of bore I on the line of section AB the average specific

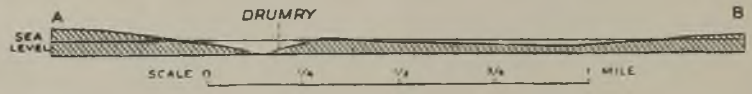


Fig. 2.—Section along Line AB, Fig. 1.

The surface topography, especially to the north of Drumry, is irregular, slopes of 4°–5° being common. It was found, however, quite feasible to evaluate the terrain and topographical corrections in such unfavourable sites and to obtain reliable and consistent residual gradients from the balance readings.

Results of Survey—*I. The Rock mass South of Drumry.*—The map, fig. 3, shows the gradients corrected for normal, terrain, and topographic effects, and also surface contours at intervals of 5 feet to indicate the type of topography in those areas where topographic corrections were found necessary. Fig. 4 shows the gradients and the isogam lines constructed from them. The presence of the rock-mass south of Drumry is clearly demonstrated by the consistent group of gradients directed westwards, and the isogams give some idea of its shape and dimensions. The gravitational results plotted on the two maps show (1) that the rock-mass has a steep eastern face; (2) that this steep face is incised in places; and (3) that the rock-mass in general form is a ridge, with an irregular upper surface, stretching westwards for some distance.

(1) The steep eastern face is qualitatively shown by the large gradients directed westwards and by the close, parallel isogams. Fig. 5 shows the curve of average gradients, (A), plotted along the line AB in the isogam map, fig. 4. This curve bears a close resemblance to the theoretical gradient curve, (B), drawn for a monocline, with horizontal top, of the dimensions shown in the upper part of the diagram. The actual difference between these two curves is shown by the third curve, (A)–(B). This difference is too large to be disregarded. If, instead of a horizontal top, a gentle rise westwards (slope=2½°) is assumed, as shown in the figure, then the difference between the curves, (A) and (B), can be completely accounted for. The points, indicated by circles, show the values of the theoretical gradients calculated for the wedge-shaped mass that forms the gentle rise. The close correspondence between these points and the difference curve, (A)–(B), indicates that the experimental results can be interpreted as due to the westward rise of a rock-mass in the manner illustrated in fig. 5; that is, the gravity of the rocks beneath the drift was calculated as 2·38. If, as assumed, the specific gravity difference is ·55, we obtain the value 1·83 as the average specific gravity of the drift; the average of 13 determinations at the surface gave the value 1·72.

(2) The isogam map, Fig. 4, shows that the eastern face of the rock-mass is incised in three places; the best defined of these incisions being the one immediately south-west of the brickworks. Fig. 6 shows the curve of average gradients along the line DE on the isogam map. Rough calculations show that the hollow causing these gradients is about 200 ft. wide, with a possible depth to rock of 150 ft. from the surface. Bore No. 1 on the line AB showed rock at a depth of 74 ft. from the surface, and bore No. II south-west from the brickworks showed rock at a depth of 114 ft. The gravitational results and the geological evidence thus both indicate a hollow; its sides are approximately in the position shown by the two parallel lines drawn perpendicular to the line DE on the isogam map.

Two other embayments are indicated, one to the north and one to the south of the hollow just described, but there is not a sufficient number of gradients and isogams to define them with certainty.

(3) The westward extension of the rock-mass is shown by the isogam map, which also indicates that there is a gentle but persistent rise to the south and west. As a result of this approach of the rock to the surface, small irregularities such as local knobs and hollows will cause considerable local variations in gradient both in magnitude and direction. Reference to Fig. 3 will show that such rapidly changing gradients were encountered in the south and west of the areas surveyed. Attention may be directed to the gradients north of the chemical works on the west edge of the map. The gradients indicate a rock knob south of the railway, with a hollow on the south and another rise farther south towards the canal. At the chemical works itself a bore shows 116 ft. of drift. These local heights and hollows may be compared with the deep hollow already referred to south of the Drumry brickworks, and indicate that for a

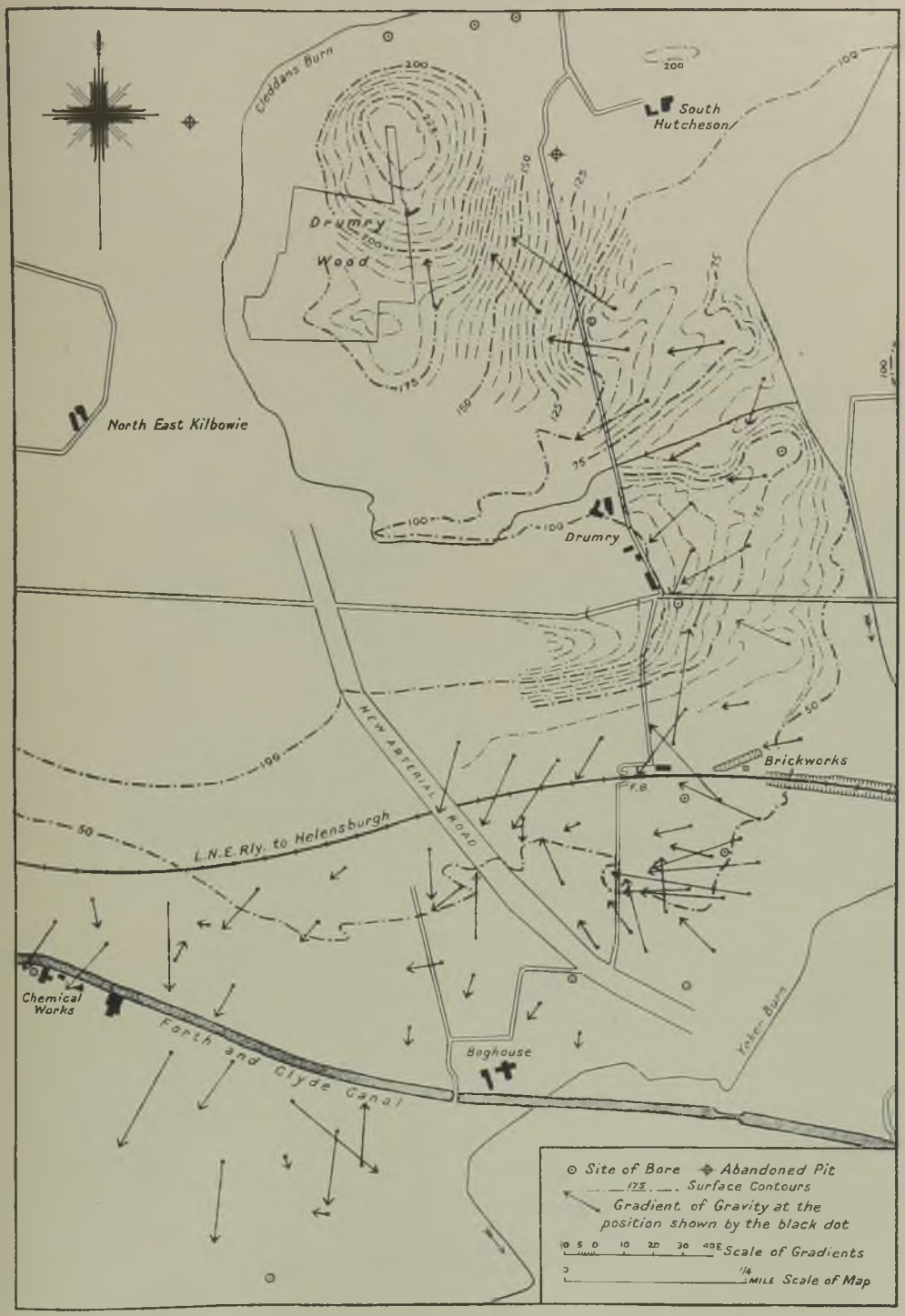


FIG. 3.—GRADIENT MAP OF THE DRUMRY DISTRICT.

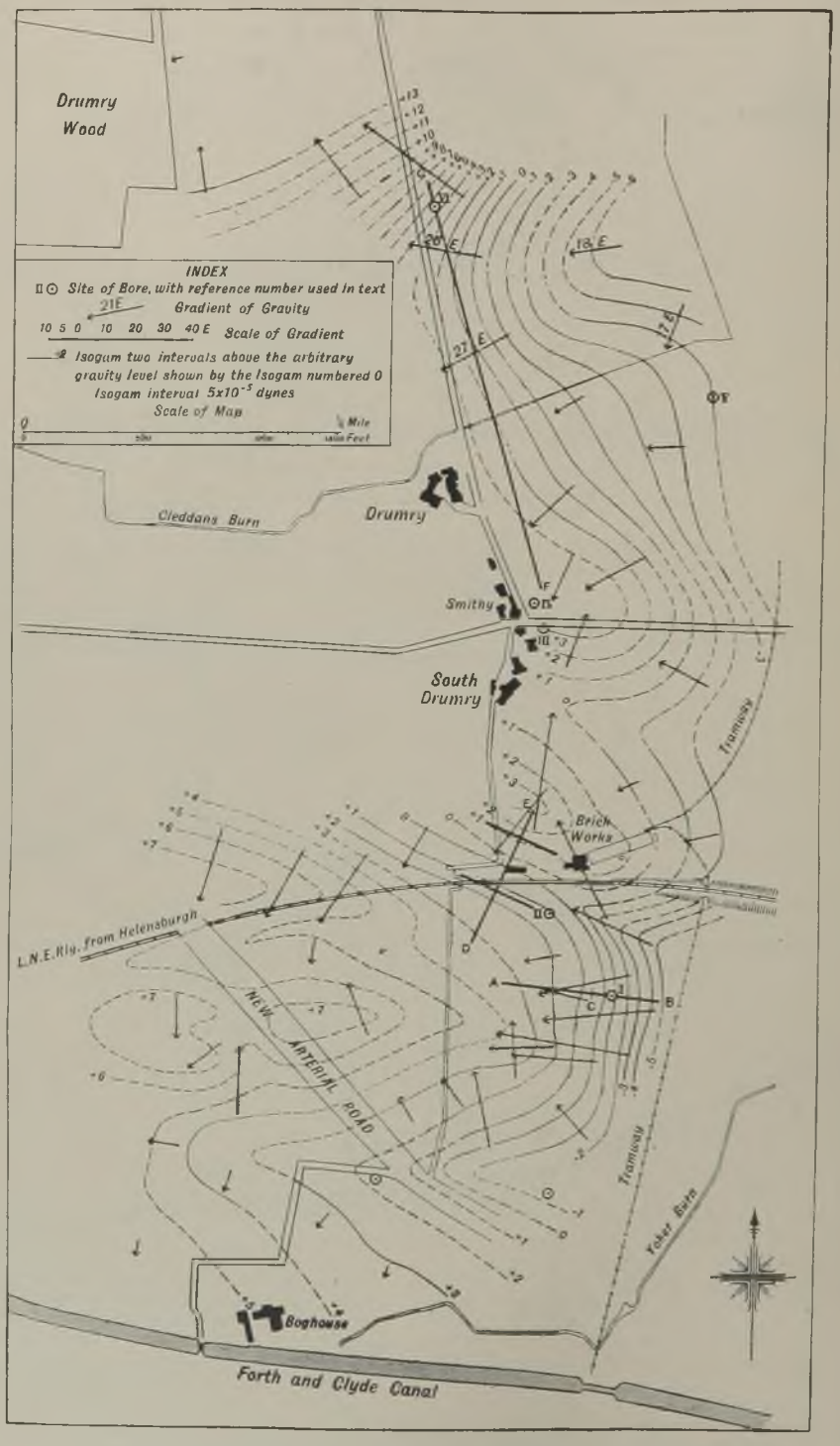


FIG. 4.—MAP SHOWING GRADIENTS AND ISOGAMS AROUND DRUMRY.

thorough investigation of a shallow buried topography a very close network of stations is necessary.

II. The Buried Channel North of Drumry.—The map, Fig. 1, shows a deep channel north of Drumry continuing westwards for a distance of at least 1 mile. It has been pointed out that the contours of the buried channel in that area are largely conjectural owing to the bores on which they are based being so far apart. It was therefore of importance to find out if a traverse with the balance across the presumed strike of the valley would yield confirmation of this interesting geological inference.

to follow the line FG, approximately 1,000 ft. west of bore V, to lie at a depth of 100 ft., and to continue indefinitely northwards, then we should expect a maximum gradient of approximately 37 E.[1] towards the west; above bore V the gradient should be approximately 16 E. If the top swings east at a distance 1,500 ft. north of bore V, then the presence of this rock lying north and north-east of bore V will cause these westerly gradients to be diminished by about 5 E.; that is, we must compare our observed values with a calculated maximum of 32 E., and above the deep part of the channel near

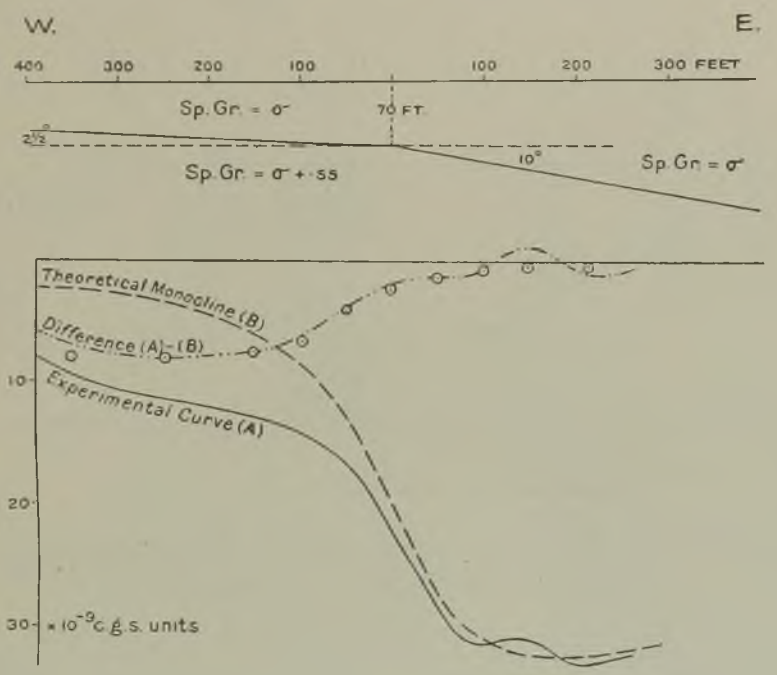


FIG. 5.—STRUCTURE; THEORETICAL AND EXPERIMENTAL GRADIENTS ALONG THE LINE AB OF FIG. 4.

On the assumption that the buried channel extends as shown on the map, Fig. 1, we should expects to obtain from a traverse across the strike, northwards from Drumry, a series of gradients similar to that yielded by a traverse across a syncline.[1] The results plotted on the isogam map, Fig. 4, show, however, that the buried channel does not continue westwards but bends to the south about ½ mile north of Drumry. The consistent westerly trend of the gradients and their magnitude indicates clearly a western bank which appears to be a northerly trending continuation of the rock-mass south of Drumry.

The boring evidence is shown on the isogam map, Fig. 4. Bores III and IV showed drift of a thickness of 93 ft. and 126 ft. respectively, but unfortunately there is no record of rock being reached at either of them. At bore V rock was reached at a depth of 298 ft., and at bore VI the depth to rock was 132 ft. If we assume the top of the western side of the valley bore V, a value of 11 or 12 E. These are actually of the same order as the observed gradients, but are somewhat larger. This indicates that the hypothesis of a right-angled bend of the channel north of Drumry agrees qualitatively and quantitatively with the gravitational observations; and it may also be deduced that the top of the western bank is approximately beneath the line FG and lies at a greater depth than 100 ft.

COMPARISON OF GRAVITATIONAL RESULTS WITH GEOLOGICAL EVIDENCE.—The results described above demonstrate the usefulness of the torsion balance for mapping the features of sub-drift topography and for supplementing and extending the information yielded by isolated borings. In the course of the survey it became clear that the gravitational results, as in the case of the steep eastern face of the rock-mass south of Drumry, confirmed in all respects previous geological inferences when these were based on a sufficient

[1] Summary of Progress for 1926, *Mem. Geol. Surv.*, 1927, p. 191.

[1] 1 E. = 1 Eötrös unit = 1×10^{-9} c.g.s. unit.

number of borings. The westward extension of that mass indicated by the balance results shows how the gravitational method may supplement such information.

With regard to the deep extension of the buried valley of the Kelvin to the north-west of Drumry the gravitational results show that no deep gorge, such as that indicated on the Survey Map, exists, but that the ancient river valley takes a sharp bend southward and flows between Drumry and Drumchapel. Whether the great depth of drift known from boring evidence to exist in the bend, and confirmed by the balance results, is the normal depth of the old river valley, or whether it may be a local overdeepening by glacial or other erosive process, remains an open question. The remainder of the paper is taken up with details of practice, with calculations and interpretation.

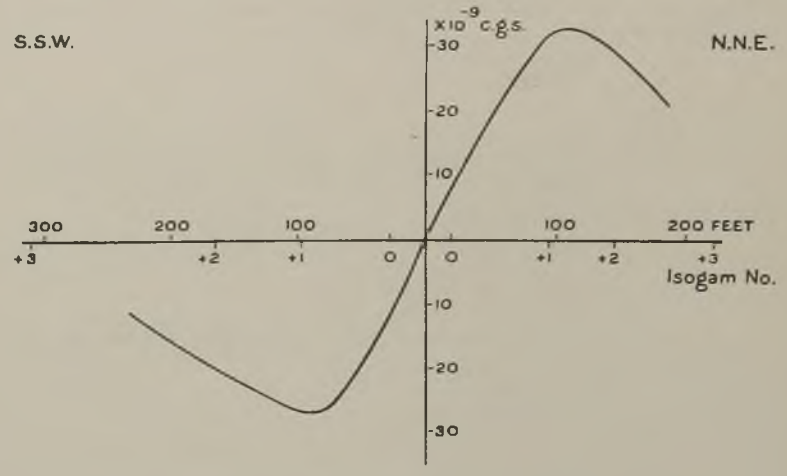
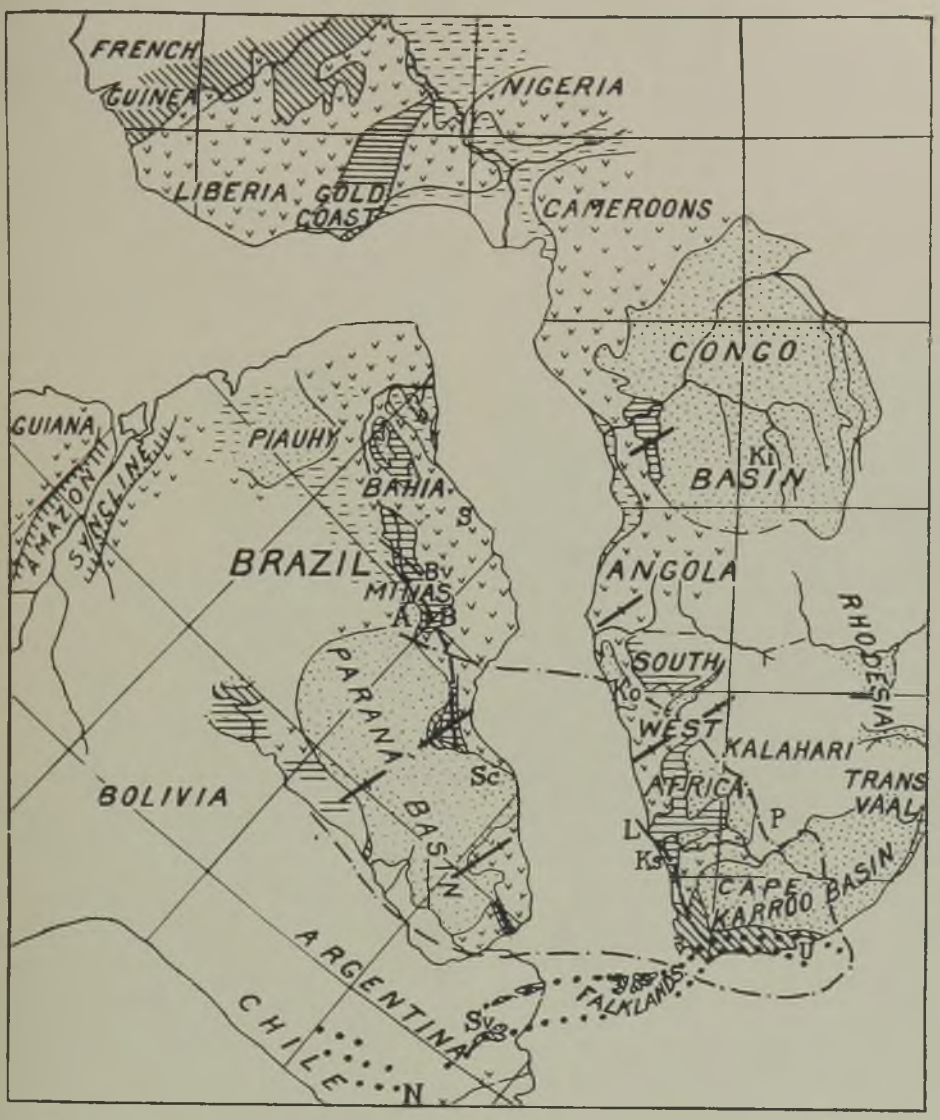


Fig. 6.—Curve of Average Gradients along the Line DE of Fig. 4.

SOME REFLECTIONS UPON A GEOLOGICAL COMPARISON OF SOUTH AFRICA WITH SOUTH AMERICA

The *Proceedings* of the Geological Society of South Africa, 1928, contain the Presidential Address to the Society by A. L. du Toit, the subject being a geological comparison of South Africa with South America. The author points out that evidence can be presented pointing strongly in the direction of the conception that in the past South America was united more closely to Africa than at present, but that these two masses became forcibly separated during the late Mesozoic through gigantic crustal movements, as portrayed under the now well-known "Continental Drift" or "Displacement Hypothesis," with which are particularly connected the names of Taylor and Wegener. His researches in South America in 1923 have disclosed a wealth of unexpected data strongly favouring these heterodox opinions, and for the first time the Displacement Hypothesis can be regarded as having been placed upon a quantitative basis. The following is a brief summary of the evidence showing that in the past these two great land-masses not only must have formed portion of the old continent of Gondwanaland, but were possibly closer together in a geographical sense.

General Comparisons of South Africa with South America.—Striking is the behaviour of the pre-Devonian systems contiguous to the South Atlantic—the Nama of the Cape and South-West Africa, with its quartzites, slates, limestones and dolomites, and the lithologically similar early Palaeozoic or Proterozoic strata of South America, each system resting unconformably on the Archaean granites or Eozoic, and folded along axes approximately parallel to the respective coastlines. These foldings, which are mainly pre-Devonian in age, run from Lüderitz to Caledon and from Minas, in Brazil, to Maldonado, in Uruguay, respectively, becoming generally more intense towards the south, where the strata have furthermore become invaded by bodies of younger granite. Upon this framework repose the relatively little-disturbed Devonian and Gondwana sediments of each country. In the south of the Cape and in Argentina, just to the north of Bahia Blanca, identical Palaeozoic formations are developed that are folded in precisely similar fashion. The Table Mountain Sandstone and the fossiliferous Bokkeveld Beds find their equivalents and duplicates in the quartzites and slates of the Sierra de la Ventana ranges, the Witteberg quartzites and shales are represented by cleaved greywackes, the Dwyka tillite by identical boulder-beds with glacially striated erratics followed by sediments corresponding with the Ecca of the Southern Karroo. Striking, too, are the dissected terraces capped with consolidated ferruginous and silicified high-level gravels like those of Swellendam and Heidelberg. Exactly as in the South of the Cape, this conformable succession in Argentina has been



SUGGESTED CONTINENTAL RESTORATION UNDER THE DISPLACEMENT HYPOTHESIS: A, Agua Suja; B, Burnier; Bv, Bôa Vista; Ki, Kasai; Ko, Kaokoveld; Ks, Klein See; L, Lüderitz; N, Neuquen; P, Postmasburg; S, Salobro; Sc, Santa Catherina; Sv, Sierra de la Ventana; U, Uitenhage.

intensely crumpled through pressure exerted from the south and the beds even overturned in places towards the north during some period at about the close of the Permian or the beginning of the Triassic. Indeed, these Argentine fold-ranges were, so long ago as 1916, regarded by Keidel as the extension of the " Cape Foldings " across the Atlantic. Traced towards the north-west into Western Argentina, the glacials are found to have overlapped unconformably upon the palaeozoics, just as is the case in Calvinia of Natal, while not only are *Glossopteris* and other plants found associated with them, but a marine phase near San Juan containing *Spirifer, Productus,* etc. Both the plants and mollusca prove the glaciation there to have come to an end within the early Upper Carboniferous and the refrigeration must, therefore, have commenced during about Mid-Carboniferous time. This in turn suggests that such was most likely the case in South Africa also, and, indeed, the scanty flora of the Witteberg Series, that underlies the Dwyka, exhibits affinities with the vegetation of the Lower Carboniferous and Upper Devonian. Remarkable is the sequence in Paraná State, with its flat-lying Furnas Sandstone, Ponta Grossa Shales (Lower Devonian) and unconformable Carboniferous glacials, that duplicate the equivalent Table Mountain-Bokkeveld-Dwyka succession of the Clanwilliam district. The author also compares the north of Patagonia and the Uitenhage district, inasmuch as in each area Triassic sediments and volcanics rest with marked unconformity upon the folded Palaeozoics, and have been folded by mid-Cretaceous movements, while in Neuquen Cretaceous marine beds have been found carrying a Neocomian fauna, differing from that represented elsewhere in Argentina, and typically " Uitenhage. "

From Uruguay northwards, through South-Eastern Brazil into the States of Goyaz and Minas Geraes, extends the great Paraná Basin across a distance of at least 1,000 miles, the precise counterpart of our Karroo Basin, to which it is amazingly similar in its stratigraphy and fossils. The strata composing it, comprehensively known as the Santa Catherina System, repose unconformably upon the basement rocks, and generally commence with the Itararé, an essentially glacial series, the products largely of a vast continental ice-cap, one that apparently moved from south-east to north-west, and which is closely comparable with the Dwyka. The succeeding Bonito Group, with a fossil flora very like that of the Ecca of Vereeniging, contains the only workable coals of Brazil, though these furnish a highly ashy and pyritic fuel. Widespread and persistent is the thin group of the Iraty Shales, a carbonaceous, pyritic, calcareous and white-weathering formation identical with the " White Band " of the Cape and South-West Africa, and, like the latter formation, characterised by the unique reptilian genus *Mesosaurus*, wherefore the identity of these two zones is fixed beyond all question. Significant is the fact that this fossil is not known to occur either to the north-east of a line drawn from Grahamstown to the Kaokoveld or to the west of the Paraná-Paraguay River.

Most of the Ecca and Beaufort Series find no equivalents in the Paraná Basin, for, owing to a stratigraphical gap—though without any angular or visible unconformity—the succeeding Triassic beds have come to transgress across the lower groups, and even to rest in places upon the basement rocks, thus repeating the conditions to be found in the Transvaal, Rhodesia, and the Kaokoveld. In South America this overlapping was initiated by a marine invasion, as proved by fossiliferous bands in the Estrada Nova Series, which has not yet been recorded in South Africa, but the succeeding strata of both countries are of continental origin, and display marvellously similar characters. The Stormberg Red Beds and Bushveld Marls find their equivalent in the even more vivid Rio do Rasto " red beds," with brilliant mudstones and sandstones, while the following creamy and pink Cave, Bushveld and Forest Sandstone is duplicated by the all but identical Botucatú Sandstone, so well developed in the State of Sta. Catherina. Both of these formations, moreover, appear to have been laid down mainly by aeolian action during a period of aridity at the very close of the Triassic ; silicification is common in them. The succeeding Stormberg Basalts are furthermore paralleled by the enormously widespread Serra Geral eruptives of similar composition and habit, which effusions, in addition, terminate the Gondwana succession in each country, while the strata beneath have in each case been penetrated by a network of basic sills and dykes—the well-known Karroo Dolerites. Significantly, these volcanic groups build the actual shore line only in Sta. Catherina State and across the Atlantic in the Kaokoveld. Further to the north the huge area of Karroo beds of the Congo Basin finds its duplicate in the lesser tract of Permo-Triassic, with cappings of basalts in Piauhy and Maranhão. It is further important to note that the Cretaceo-Tertiary marine beds of the Benguella-Lower Congo littoral and those of Bahia and Sergipe not only contain similar faunas of Atlantic and Mediterranean facies, but constitute the only sections of the Atlantic margins where such youthful strata have suffered appreciable folding and faulting. Away from the ocean horizontal Cretaceo-Tertiary beds, both continental and marine, occupy huge areas in Cameroons and Togoland and in Ceará and Maranhão. Lastly, the great Palaeozoic syncline of the Amazon Valley may be compared with the broad development of such slightly disturbed fossiliferous marine strata in French Guinea, Gold Coast and the Sahara. Attention is drawn to the Falklands, because these two islands, though situated far away to the south-west, belong stratigraphically and structurally with the Cape and not with Patagonia. The developments of the Cape and Karroo Systems within them all but duplicate those of the south-western Cape, though there is a strong tendency towards characters intermediate between those found in the latter region and in the closely comparable Sierra de la Ventana area of Argentina, that we have already discussed.

The parallelism between South Africa and South America set forth in the above summary will, the author ventures to think, be admitted by all as truly amazing, though the majority of persons would be disposed to regard those resemblances as due to a mere series of coincidences. This, however, is strikingly discounted by the study of the phasal variations displayed by the major rock groups involved. Traced within each continent every important formation comes in accordance with well-known stratigraphical laws to exhibit more or less marked variations in lithological characters, in thickness, etc.—or as it can be expressed, changes of " facies." Now it can be shown that equivalent formations situated on or near the two opposed shores of the South Atlantic tend in most extraordinary fashion to reveal closer resemblances to

one another than to their actual extensions within the respective continents. This, indeed, forms one of the strongest arguments for the Displacement Hypothesis, for mere similarities in the lithology, etc., of such widely parted territories are equally though not readily explicable on orthodox lines, while the present biological distribution, apart from confirming the idea of the former union of certain of the land-masses, cannot in itself be used as testimony towards the hypothesis of continental drift.

It has been observed of the great " rift valleys " of the globe that their plateau-edges tend to be turned up, a peculiarity which should under the displacement hypothesis characterize the margins of fractured crustal blocks of the type we are considering. One of the most outstanding physiographical features in South Africa is the " Great Escarpment," the origin of which has interested so many geographers. During the Tertiary this lengthy watershed must undoubtedly have lain much closer to the present sea-board, for its edge has since retreated far inland and has also been lowered by erosion. It is suggested that the larger rivers take their rise at the inner edge of this feature, and cross the great interior region, passing out through gaps in the rim, either somewhere in the same quarter after making a long detour, or else on the opposite side, for example the Orange, Zambesi and Niger. An identical arrangement is presented in Brazil by the Paraná, Rio São Francisco, etc. The author asks, therefore, may we then not regard the phenomenon of the Great Escarpment as indicating that the southern end of the African continent must have been shaped primarily by gigantic tension fractures rather than by the mere down-warping of immense tracts of land that connected it with the surrounding masses ?

ONVERWACHT PLATINUM PLANT

In the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa for January, 1919, is a paper by T. K. Prentice and R. Murdoch giving the following account of the four years' research which culminated in the recovery of platinum on a commercial scale from the Onverwacht ore.

The first discovery of platinum in the Transvaal in what appeared to be payable quantities was made in the Waterberg district in 1923 by Adolph Erasmus. This was quickly followed by discoveries in the Lydenburg district, first by A. F. Lombard in August, 1924, at Maandagshoek, and, secondly, and quite independently, by W. F. Blaine in October, 1924, on the Farm Onverwacht. The manner of the occurrence of the metal in the Waterberg and the Lydenburg districts is entirely different, for, whereas it is found in a quartz lode in the former, it occurs in the latter as a primary constituent of ultra basic and basic rock in the form of a remarkable dunite, called hortonolite dunite because of its richness in ferrous oxide. This hortonolite dunite is found in segregations within larger bodies of olivine dunite, there being a gradual transition from the one into the other. The olivine dunite also exhibits a transgressive relation to the surrounding rocks of the bushveld complex.

Onverwacht lies in the western part of the Lydenburg district, about eight miles from the railway terminus at Steelpoort and about 55 miles by road from Lydenburg. The dunite rock, which has no definite horizon, forms a long, low ridge that rises about 300 feet above the valleys on either side. Enclosed within the olivine dunite lies the main hortonolite orebody in the shape of an almost vertical circular columnar body about 60 feet in diameter at the surface, the actual dip being about 78° to the south-east. The outcrop of this columnar body formed a small knoll on the western slopes of the dunite ridge.

The hortonolite dunite is of striking appearance, being a dark, heavy rock, weathering with a characteristic rust-like crust. On freshly fractured surfaces the colour ranges from deep honey-brown to greenish-brown. It is coarse-grained and has the distinction of being the heaviest igneous rock, composed essentially of silicates, hitherto described from any part of the world, the specific gravity varying from 3·7 up to 3·9 in chromite-rich varieties. Chromite is present in sharp-edged octahedra and in irregular and rounded grains, for the most part completely enclosed by the silicates. Magnetite is also sometimes in evidence.

The dunite is regularly jointed and weathers in rectangular slabs. The horizontal and vertical joints, up to 4 in. wide, are filled with magnesite, and are very conspicuous in the open working between the surface and the 65 ft. level. Naturally they also extend below that level. The mineralogical composition of a typical fresh-looking piece of dunite from Onverwacht is given by Drs. Wagner and Mellor as :—

	Per cent.
Hortonolite	93·2
Diopside	5·0
Hornblende	1·5
Chromite	·25
Magnetite	·05
	100·00

The slopes of the ridge below the knoll are covered with rubble derived from the disintegration of the hortonolite dunite. The rubble, apart from containing a good deal of residual chromite, is very similar to the hortonolite in place, and carries platinum in fair quantities.

Occurrence.—The platinum is irregularly distributed through the hortonolite, and occurs in cubes or irregularly rounded nuggety forms. The largest nugget recovered to date was found in the stamp mill mortar box. On one side the nugget showed a clean fracture, indicating that it had already been broken by a blow from a stamp. The measurements of the nugget were 0·56 in. by 0·67 in. by 0·20 in., and the weight 9·5 grms. Other nuggests approaching this size have been found, but most of the platinum is much finer, ranging down to the very finest. The platinum may be enclosed in the hortonolite or in contact with the chromite in the rock. Most

of the best specimens found have been associated with chromite, and the highest assay values are from rock showing chromite. At the 250 ft. level, where very rich values were encountered, much ilmenite was present, although nearly all the rock was richer, whether associated with ilmenite or not.

The platinum is malleable and ductile, and varies in colour from pale yellowish white through greyish white to silvery white. Some of the crystals and grains are magnetic, while others are not. Typical analyses of the metallics are as follows :—

	From surface. %	From 200 ft. depth. %
Pt.	84·00	84·75
Os. Ir.	2·30	0·95
Rh.	0·20	Trace
Pd.	0·30	0·53
Cu.	Trace	1·28
Ni.	——	0·48
Fe.	12·80	11·98
	99·60	99·97

These analyses are very similar to that of the platinum in the Ural Mountain deposits.

Early Tests.—The coarseness and high specific gravity of the metal, with consequent ease of recovery in the panning dish, indicated that the primary steps towards recovery should be to crush to an economic limit of fineness, determined by the freeing of the metal from its matrix, followed by mechanical concentration to its limits. On these lines the first experiments were carried out. For this purpose, representative samples, which had been sent to the Rand Mines Laboratory for assay, were made into 20 lb. lots, crushed to about –60 linear mesh, and dressed on a curvilinear table and divided into two products—concentrate and tailing. The results of these tests carried out in March, 1925, showed that gravity concentration would give, from a 15 dwt. ore, 80% extraction into a concentrate weighing 20% of the original ore. The concentrate assayed 60 dwt. per ton. All these assay figures and those that follow are in terms of platinum group metals.

Following these tests, in April, 1925, a 300 lb. parcel of ore was forwarded to the Laboratory, crushed to –48 linear mesh and dressed on the curvilinear table. The ore assayed 28·6 dwt. per ton; the dressing gave a concentrate weighing 2·78%. of the original ore and assaying 880 dwt. per ton. The extraction was 84%. Another sample assaying 10·9 dwt. per ton, treated in a similar way, gave an extraction of 83% into a concentrate weighing 2·1% of the original and assaying 527 dwt. per ton. The two latter tests were sufficiently encouraging to justify the erection of an experimental plant in Johannesburg, at the Ferreira Deep Mine, adjacent to the mill building, so that gravity stamps could be used to pulverize the ore prior to concentration. and enable the scale of operation to be enlarged. Moreover, experimental work was now being carried out on the concentrate, and it was necessary to produce this on a larger scale. This plant was erected and running in August, 1925, and consisted of three stamps, a standard size curvilinear table, ball mill for regrinding middlings when desired, and corduroy tables for treating the tailings. Sand and slime could be separated if required, and vats were provided for collecting all the products. In all, about 14 tons of dunite ore were treated in this plant. These tests confirmed the previous results, and indicated that, in a concentrate weighing about 1·7% of the original ore, an extraction of 83% could be obtained, into a concentrate assaying about 600 dwt. per ton.

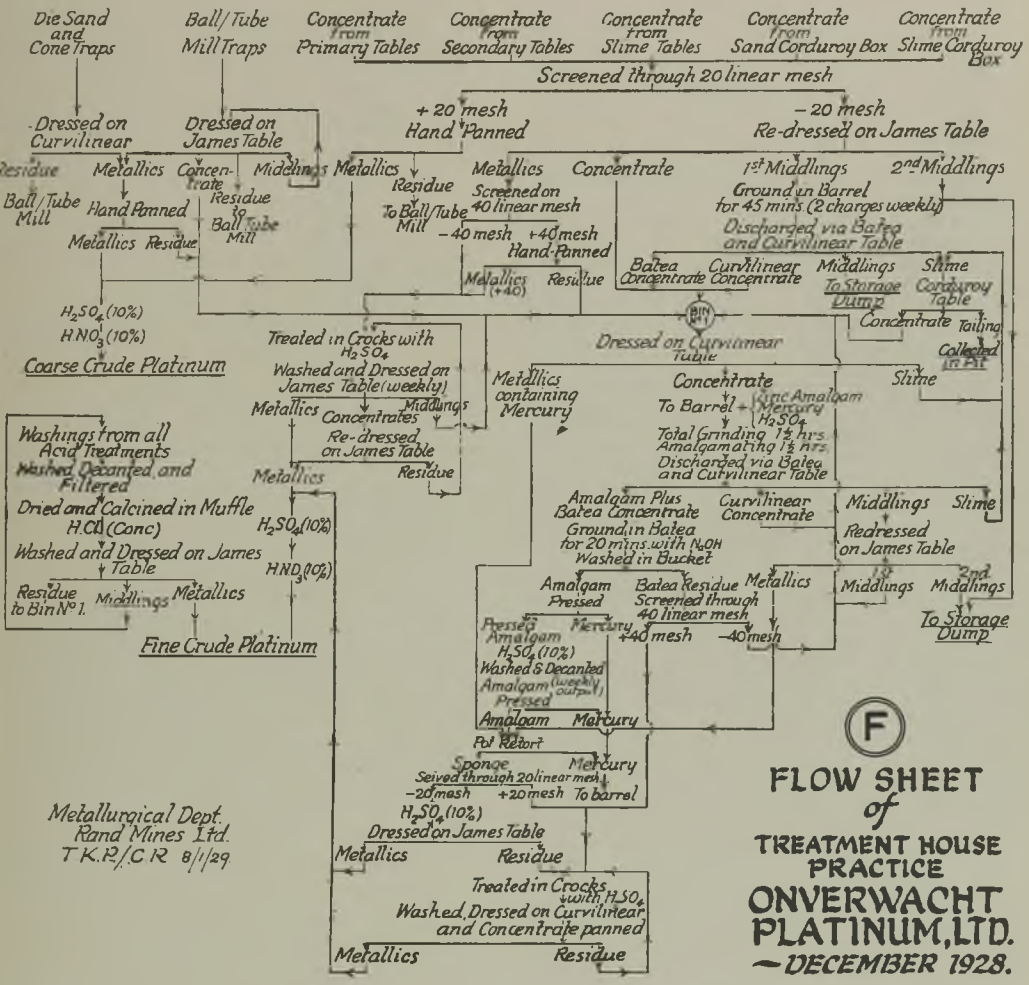
First Plant.—With the information on concentration obtained, and promising results from the laboratory tests on the treatment of the concentrate, it was decided to erect a reduction plant on the mine. However, at this stage, it was considered advisable to erect a small plant only, capable of treating about 1,000 tons per month, as a pilot plant, which would help to formulate the flow sheet to be finally adopted. In the meantime the Laboratory staff were engaged in research work on the further enrichment of the concentrate. Six hundred dwts. platinum-group metals per ton is approximately only 0·1% and the desirability of enriching this up to at least 50% for subsequent handling by the refiners is very obvious. Cyaniding, chlorination and straight amalgamation were tried, but proved of no avail. However, an amalgamation process in which the amalgamation of the platinum is promoted by activating re-agents in the form of Zn amalgam, $CuSO_4$ and H_2SO_4, gave such encouraging results that it was investigated thoroughly. This process being in essence that described by V. J. Zachert in *The Mining and Scientific Press* of October 12, 1918, was not patented. The reactions were obscure, and many experiments were carried out to elucidate what did happen.

As a result of these experiments, it appears that the formation of hydrogen, whether generated by electric couple or by the action of the acid on zinc, is essential. The nascent hydrogen with the zinc amalgam forms hydrogen zinc amalgam, which, like hydrogen sodium amalgam, has a remarkably powerful amalgamating action and an affinity for platinum. Nascent hydrogen itself is commonly made use of in gold metallurgy to reduce many substances which interfere with amalgamation. Tests were made in which the nascent hydrogen was produced solely by electrolytic couple and not by the action of H_2SO_4 on Zn. Zinc and platinum constituted the couple, and the electrolytes tried in different tests were caustic soda, sodium chloride and ferrous sulphate. The residues from these tests assayed respectively 17·5, 21·3 and 22·3 dwts. per ton, whereas, when, in addition to the zinc-platinum couple, H_2SO_4 was used, the residue from the same concentrate was 3·0 dwt. Copper sulphate is not essential to the reaction, but, by the precipitation of copper from the sulphate by zinc during the amalgamation, improved results were obtained. Platinum by itself will not precipitate copper from copper sulphate when acidified with H_2SO_4.

At the Laboratory, 10 lb. lots of concentrate were charged into a small amalgamating barrel with mercury, $CuSO_4$, H_2SO_4 solution and zinc amalgam. A few chert pebbles were added and the barrel was revolved for an hour and a half. It was then discharged into a bucket and the residue eliminated by water agitation on to a copper amalgamated plate and finally over a curvilinear table, from which the tailings were collected. The curvilinear concentrate and the scraping from the plate were returned to the amalgam in the bucket, and the residue therefrom, when cleaned with the greatest care, was added to the curvilinear tailing. The amalgam was then retorted without squeezing, because of the very small amount of platinum present, and the retorted sponge, which contained base metals, cleaned with acid. In this way a

recovery of 98% was obtained from the concentrate into a product assaying about 70% platinum group metals. If the residue from the first amalgamation happened to be unsatisfactory, the residue was reduced without exception by a second amalgamation carried out in the same way. Cyanide and chlorine tests were made on the amalgamation residues, from which about 30% extraction was

tipped on to a horizontal grizzly and the + 2 in. shovelled therefrom into the 9 by 12 in. jaw crusher, when it dropped and mixed with the — 2 in. in the stamp mill bin. From the stamps the pulp gravitated to the dewatering cone, the underflow of which passed through the Wilfley ball/tube mill and the overflow passed round and joined the ball/tube mill outlet at the distributer



obtained, but, in view of the low value of the amalgamation residues, this research was not pursued.

Reduction Process.—Such progress was made with these tests that it was possible to plan and build a concentrate treatment house at Onverwacht, which was ready for operation at the same time as the crushing and concentrating plant, the complete reduction plant being started in January, 1926. It was erected on the hillside, adjacent to the orebody, in such a position that the rock could be trucked by native labour along a level track from the shaft bin to the crusher. Here the rock was

which fed the four primary Wilfley tables. These was thus no return system. The concentrate from these tables was collected in locked boxes. The middlings gravitated with the addition of clean water to the secondary Wilfley table, from which the concentrate was also collected in a locked box. The tailings from the primary tables joined the tailings from the secondary table and passed by gravity over two corduroy tables, thence to the tailings dam. The concentrate from the Wilfleys was weighed and taken over to the treatment house daily. The corduroy concentrate was collected in a washing box and fed daily over one of the

primary Wilfleys, during which time special adjustments were made. Thus it will be seen that the passage of the ore through the plant was entirely by gravity. The tailings, carrying a considerable quantity of sand, passed into a cone at the dam, the underflow being collected in trucks and trammed around the wall of the dam, while the cone overflow and truck overflow were collected within the wall, in the same way as slime on the Witwatersrand. The water gravitated via a penstock to a pump, by which it was elevated to the mill water steady-head.

The treatment house equipment consisted of a standard size, amalgamating barrel, batea amalgamated copper plate, curvilinear and corduroy tables, with the usual accessories for handling and treating amalgam. The treatment house operations will be dealt with later in this paper.

The power plant consisted of two 60 h.p. gas engines, running on producer gas obtained from bituminous coal, and driving a common line shaft. From this shaft were driven the stamps and Wilfleys, and a 500 volt three-phase electric alternator which rendered available electrically the balance of the power output. The ball/tube mill, treatment house plant, and pumps were driven electrically. The make-up water supply came from wells sunk in the bed of an intermittent stream on the opposite side of the hill.

It was decided to crush with stamps only for the first month, using 1600 square mesh, three primary Wilfleys, the secondary Wilfley and the corduroy. During this time the crushing was at the rate of 23 tons per day, giving a stamp duty of 4·8 tons per 24 hours. Unfortunately, the percentage recoveries for this period are not available due to delay in the completion of the assay office, which caused considerable inconvenience. However, the several samples sent to Johannesburg for assay indicated that the extraction in the concentration house was in the neighbourhood of 83%. The weight of concentrate produced during January was 1·76% of the ore crushed.

The ball/tube mill, fitted with a peripheral discharge grid, was started on February 17, 1926. This mill, 4 ft. 6 in. diameter by 6 ft. long, was charged with 1½ tons of 3 in. balls pending the arrival of 1 in. slugs which were on order. The slugs were put in on March 15, the load then being one ton of balls originally 3 in. and one ton of 1 in. slugs. From experience gained the stamp mill screen was changed from 1600 to 400, from that to 64 mesh and finally to 9 mesh from May, 1926.

In view of the satisfactory results obtained in the pilot unit it was decided in June to double the capacity of the reduction plant. This was taken in hand without delay, and by November the increased plant was in operation. Attempts were made, without decisive results, to determine the constant amount of platinum, irrecoverable by mechanical means, existing in the tailings. For this purpose many gradings of the tailings and assays of each grade were made and studied. The indications were that the irrecoverable platinum approximated 0·40 dwt. per ton.

Tests indicated the readiness with which the metallics could be trapped before passing to the concentrating tables, and emphasised the advantages of crushing in as many stages as possible, and removing platinum by gravity concentration between each stage. In the new plant, therefore, traps were installed between the stamps and the ball/tube mill, and again between the ball/tube mill and the primary Wilfleys, and provision was made to regrind the primary middlings before dressing on the secondary Wilfleys. The concentration efficiency of the primary and secondary Wilfleys under different loads, speeds and the length of stroke was determined. Corduroy data were collected, and the inclusion of the corduroy was definitely justified, insomuch as it acted as an excellent safeguard against loss of platinum due to possible mishaps in the tabling section.

The pilot plant was run for a week with the ball/tube mill and a cone in closed circuit, the ball/tube mill outlet being elevated back to the cone at the inlet end of the ball/tube mill. Thus the only outlet for the platinum was via the cone overflow. It was found that the platinum circulated until ground so fine that recovery on the Wilfleys dropped and that the recovery by amalgamation was adversely affected also. This undesirable fine grinding in one stage was therefore discarded.

Further experimental tests indicated the advisability of removing the slime from the ball/tube mill cone overflow and tabling the slime separately on James slime tables.

New Plant.—All of the foregoing features were incorporated in the new plant. In this plant the rock from the mine, broken to less than 8 in. cubes, is trammed and tipped into a small bin which feeds a 20 in. by 10 in. Blake jaw crusher. The crushed ore falls on to a conveyor belt, by which it is elevated to the mill bin of 75 tons capacity. The bin feeds ten 1,450 lb. Californian stamps. The pulp therefrom passes via a trap to the cone of the new ball/tube mill, which measures 5 ft. by 4 ft. 4 in. The cone underflow passes over a trap and through the ball/tube mill and then via a long sluice box trap to the primary Wilfleys. The cone overflow is further classified in a similar cone, the underflow joining the ball/tube mill outlet and the overflow passing to two James slime tables, thence via two corduroy tables to the dam. The middlings from the primary Wilfleys are elevated to a thickening cone, the underflow passing through a 5 ft. Wheeler pan before joining the overflow, which is then dressed on three tables, two being Wilfleys and the third a James sand table. The tailings therefrom join the primary Wilfley tailings and pass over six sand corduroy tables before passing on to the dam. A double-sided dipper wheel is installed to elevate the primary middlings to the Wheeler pan cone, and the Wheeler pan discharge to the secondary tables. Apart from this, the whole of the pulp flow is by gravity.

The power necessary for the new plant is generated by a 360 h.p. Premier gas plant, driving an electric generator, all individual units being driven electrically. Additional water is obtained by gravity from the side of the Lulu Mountains, about four miles distant, through a pipeline consisting of 2,000 feet of 6 in. piping and 19,000 feet of 4 in. piping. The static head is 150 feet, and the amount of water delivered to the top of the Onverwacht knoll is about 100,000 gallons per 24 hours.

Until the end of January, 1928, all the concentrate produced in the new plant, amounting to about 3% by weight of the original ore, was redressed separately on a James sand table installed for the purpose, and the concentrate therefrom amounting to about 0·9% by weight of the original ore was sent to the treatment house for amalgamation, the remaining 2·1% assaying about 4 dwt. per ton, being fed back, via the ball/tube mill, to the current

circuit. However, tests carried out indicated that not only was a poor extraction being obtained in the current circuit from this 4 dwt. product, returned without special regrinding, but that it also interfered with the efficiency of the primary Wilfleys. It was, therefore, decided in February, 1928, to keep this product out of the circuit and to store it until a future occasion, when it will be treated separately. The effect of this step was an immediate drop in the value of the concentration-house tailings and a decided improvement in the concentration-house efficiency. This improvement was offset somewhat on account of the fact that the 4 dwt. product has been classed as a treatment-house residue for the purpose of complete monthly statistics, with the result that the recovery by amalgamation showed a drop from 99% to 97%. However, the overall recovery remained the same, notwithstanding a distinct drop in ore value, and the 4 dwt. product is still available for further treatment, which would not be the case were it distributed throughout the tailings dam.

The whole of the concentrating plant functions satisfactorily with the greatest ease, and requires very little supervision. At the present time the platinum output is derived from the following sections of the concentration plant :—

	Per cent.
Die sand and traps	65·0
Primary tables	17·2
Secondary tables	15·4
Slime tables	1·1
Sand corduroy	1·0
Slime corduroy	0·3
	100·0

The consumption of steel balls in the ball/tube mill is about 2 lb. per ton crushed. Fine iron is very objectionable in the treatment house, because it cannot be completely separated by a magnet from the platinum, which itself is partly magnetic. It is, therefore, necessary to dissolve in acid all the iron collected in the treatment house, amounting to about 7 lb. daily. Because of this, an effort was made to use imported chert pebbles in the ball/tube mill in place of iron balls, but the grinding efficiency fell away so badly that the test, after a fortnight, was abandoned.

Before passing on to the amalgamation section, it is advisable to refer to the treatment given to the die-sand, cone-trap and ball/tube mill-trap concentrates, which now produce 65% of the platinum output. The ball/tube mill-trap concentrate is dressed on the James table and divided into metallics, first middlings and second middlings. The latter is redressed until eliminated. The first middlings are amalgamated. The die-sands and cone-trap concentrates are dressed on the curvilinear and divided into metallics and middlings, the latter being fed back into the ball/tube mill. The metallics from both tables are hand panned, the residue being amalgamated, and the clean metallics, after treatment with 10% H_2SO_4, followed by 10% HNO_3, are washed, dried, weighed and despatched as "coarse crude platinum." This product assays about 82% platinum group metals, the chief impurities being the base metals alloyed with the platinum. This treatment is shown in the top left-hand corner of treatment-house flow sheet F.

It has already been pointed out that very satisfactory recovery was obtained by amalgamating gravity concentrate in 10 lb. lots at the Laboratory, and that the plant at the mine was built to operate on the same lines. It was felt, however, that, although it could be done in small lots, it might not be so easy on 1,000 lb. charges. Fortunately the gravity concentrate produced at the mine for amalgamation on this larger scale resembled very closely in composition and value that experimented with at the Laboratory, and it is gratifying to be able to record that the recoveries on the large scale from the first charges treated were equally as good as those obtained in the experimental plant. Complications developed later as iron and chromite built up in the treatment-house circuit, but these difficulties, too, were overcome as they arose.

First Large Scale Procedure.—To the barrel was added the daily production of concentrate, weighing about 1,000 lb., and the mercury, zinc amalgam, copper sulphate and sulphuric acid. The three latter reagents were added in two additions. The barrel was revolved for two hours with six 6 in. balls therein, then discharged via the batea, amalgamation plate and curvilinear table. The batea concentrate, plate scrapings and curvilinear concentrate were scooped into a bucket and the gangue residue removed from the amalgam by a jet of water. The dirty amalgam in the bucket was then placed in a small dumb-bell barrel and reamalgamated with zinc amalgam, $CuSO_4$, H_2SO_4 and mercury for half an hour, after which it was discharged into a bucket, and rewashed over the batea. The curvilinear middlings were redressed on the curvilinear, the concentrate therefrom with the residue from the bucket being added to the next day's charge. The middlings and tailings from the second redressing were stored in bins according to their value, which at that time averaged about 20 dwt. per ton.

The clean amalgam was pressed and then acid treated in earthenware jars with dilute H_2SO_4 (to remove zinc and fine iron) for at least 24 hours. Since retorting was carried out weekly, some of the amalgam was actually in the acid for nearly a week. H_2SO_4 was preferable to hydrochloric acid because of the heat generated by H_2SO_4 rendering unnecessary the application of external heat. There appeared to be no loss of mercury under acid treatment as long as there was iron present. The solutions carrying black slime in suspension were decanted off and the remaining amalgam thoroughly washed with water. Care was taken that the water should not be alkaline. The decanted slime, carrying about 3% platinum, was collected by by filtration, dried and reserved for treatment.

The washed amalgam was again pressed, freeing a considerable amount of mercury, and then retorted in a small pot-retort in the usual way. The retort sponge was sieved through a 20 linear mesh screen, to break up any lumps of adhering particles and to eliminate any coarse gangue or base metals. All + 20 particles of platinum were recovered by hand sorting and panning, and added to the — 20 product, which was then treated with H_2SO_4 until action ceased. This removed some of the iron, zinc and copper. The final product was then washed and dried, and was ready for despatch, assaying about 75% platinum group metals. The solutions from this final treatment carried fine slime which was also later recovered as "decanted slime."

Within a few months it was found that by calcining the "decanted slime" in a muffle,

treating with concentrated HCl and then panning, the slime could be raised in value from 3% to about 70% platinum group metals, which could then be included with the final product, known as "fine crude platinum." This was done, and the accumulation of decanted slime was gradually worked off. From July onwards a steady recovery by amalgamation of over 98% was maintained. The coarse crude platinum from traps, etc., and the "fine crude platinum" were always despatched separately to the London refinery for convenience in refining.

The first change in the treatment-house practice, made in April, 1926, was to stop the return of the batea residue to the barrel with the next day's charge. It was found that much of this was merely circulating and not surrendering its value on further treatment. This residue was stored and special barrel charges, after grinding, were amalgamated twice weekly. Another innovation in the same month was to add lime to the batea during the discharge of the barrel. This had an immediate effect in lowering the curvilinear table residues, or, in other words, treatment-house residues. From September, 1926, caustic soda was used instead of lime.

On April 20, 1926, grinding in the barrel, either before or during the amalgamation, was stopped with unexpected improved results. At the same time, the zinc amalgam per barrel charge was increased and all the zinc amalgam, $CuSO_4$, and H_2SO_4 were added in a single lot at the start. The dumb-bell barrel was scrapped and the re-amalgamation done in an enamelled iron bucket over the batea. Care was taken not to overdo the amount of zinc amalgam and copper sulphate used in the bucket amalgamation, because it was proved that if too much were used, copper and zinc remained in the final product, and could not be removed by single acid treatment. Copper especially was particularly objectionable in refining, and it was desirable to keep this below 5%. It was known that reamalgamation of the retort sponge would have eliminated the chromite gangue entirely, but would have resulted in a metallic-looking final product, high in zinc and copper.

In spite of the foregoing precautions, the May output was high in base metal, and an investigation eventually revealed that the excess copper came from an occurrence of copper carbonate and silicate associated with the hortonolite dunite in the mine at about 40 ft. from the surface. The effect of this copper was promptly offset by stopping the use of copper sulphate entirely and giving to the concentrate in the barrel, when necessary, a preliminary weak acid wash. It is interesting to record that in September, 1926, due to a shortage of H_2SO_4, caustic soda was substituted in the barrel and zinc amalgam and copper sulphate added. Fairly satisfactory recoveries were obtained. During the three years ending 1928 that the Onverwacht reduction plant has been in operation the total output of fine platinum has been 21,820 oz.

The flow sheet F here reproduced indicates the present treatment house practice including the work done by the redressing table.

Refining Metals by Oxidation.—In *Industrial and Engineering Chemistry* for February, James Silberstein describes a laboratory method of experimentally demonstrating the refining of metals by oxidation. In the Bessemer converter iron is refined by blowing air through the molten metal. The elements phosphorus, sulphur, and carbon, which have a greater affinity for oxygen than has iron, are thereby oxidized and removed from the metal. Similarly, copper is refined and the impurities, such as lead, tin, arsenic, and sulphur, pass into the slag or fumes. Those who have had experience in the refining of metals know that part of the metal is oxidized along with the impurities and that this part increases with the purity to which the metal must be refined. The explanation is given by the author in the following description.

When their concentration is relatively large, the impurities are oxidized either directly by oxygen, or indirectly by the metal oxide which has been formed by the metal and oxygen. The impurities are therefore removed without affecting the metal. With decreasing percentages of impurities, however, such large amounts of the metal are oxidized with the impurities that part of the metal oxide passes into the slag without reacting with the unoxidized impurities. Supposing, for instance, that lead is to be removed from copper and the concentration of lead is 1 atom per 1,000 atoms of copper. Blowing air through this metal causes the formation of copper oxide with lead oxide, and, as it is a technical impossibility to bring about such an intimate mixing of metal and slag that all the rest of the unoxidized lead is brought into reaction with the copper oxide formed, copper oxide appears in the slag while there i s still lead in the metal.

The author has found that the removal of sodium from lead furnishes an easy demonstration. Pure lead on melting is covered with a bluish oxide film, which, especially at somewhat elevated temperatures, turns greyish black. If 0·2 to 0·5% sodium is added to the lead and the temperature is kept not too high above the melting point of the lead, the surface appears at first bright metallic because of the deoxidizing effect of the sodium. Soon, however, the surface is covered with a thin white film of sodium oxide. It is not necessary to blow air through the metal in this case. Exposure of the metal in the molten state to the atmosphere will bring about the refining. Simple exposure is sufficient, but stirring and drawing off the oxide film, so as to expose the metal more intimately to the atmosphere facilitates the oxidation process. If the film is removed, the bright metallic surface appears again, but it is soon covered with the oxide film. At this stage sodium alone is being oxidized by the oxygen of the atmosphere. Later the milky white film assumes a bluish tint, indicating that lead as well as sodium is being oxidized. Still later the colour changes to a bluish grey, with a milky appearance. Despite the great affinity that sodium has for oxygen in comparison with lead, a rather long time elapses before the oxide film loses the characteristic colour which is imposed upon it on account of the presence of sodium. This experiment illustrates clearly the procedure of the refining of metals on a practical basis. Much metal passes into the slag when the element to be removed has for oxygen an affinity not very different from that of the metal to be refined. A case in point is the removal of nickel from copper.

The Errington Lead-Zinc-Copper Mine.—The prospecting and development work undertaken by the Yukon Treadwell Co. in 1925 on the Errington property in the Sudbury district of Ontario has been referred to on several occasions by our Toronto correspondent. The mine started production a few months ago on a limited scale in order that information may be obtained as to the best way of treating this complex-sulphide ore. This production is sufficient to meet expenses. At the same time development is being pushed so that before long the extent of the reserves shall warrant a large expansion in the scale of operations. The president of the company is F. W. Bradley, who is known for his work at the Treadwell mines, and at the Bunker Hill and Sullivan property in Idaho, and P. R. Bradley is the consulting engineer. The concentrates are under contract of sale to the British Mining Corporation.

In the *Canadian Mining Journal* for January 11, Reginald E. Hore gives an outline of the history of the Errington mine and its scheme of development from which the following information is taken.

In 1897 a discovery was made near Stobie Falls on Vermilion River in Creighton township. Some development work was done on the Stobie claims that year under the supervision of Joseph Errington. About the same time Alphonse Ollier made a discovery a short distance east. Some work was done on this, but owing to the complex nature of the ore and the lack of evidence of quantity it did not attract serious attention for many years. In 1925 diamond-drills were sent to the Ollier property. With five drills at work the fault zone along Whitson Creek was rapidly tested, some 40,000 ft. of cores being pulled before the campaign was concluded. In 1926 a shaft was sunk, No. 1, and the ground was explored at the 300 ft. level, cross-cuts being run at 100 ft. intervals. Later a second shaft was started half a mile east of No. 1. In 1928 a third shaft was started at a point over two miles east of No. 2 shaft. During 1927 the main opening at the No. 1 shaft was extended 3,487 ft. east with cross-cuts north and south at various intervals. Connection has been made with No. 2 shaft by a 1,200 ft. cross-cut. A cross-cut has since been driven from the No. 2 shaft at the 500 ft. level. In his report for the year 1927 P. R. Bradley stated that the Ollier ore-body samples above the 300 ft. level averaged 1·33% copper, 1·33% lead, 5·74% zinc, 0·021 oz. gold, and 2·15 oz. silver.

During 1928 the company's flotation plant, erected close to No. 1 shaft, was completed and has been in operation for some months, producing zinc, copper, and lead concentrates. The early work is of experimental nature, the plant being regarded more as a pilot than as a producing unit. It is stated to be making a good recovery. Shipments made early this year were mainly for testing purposes. During the coming year the returns from shipments will be much greater. The Errington plant and buildings are substantial and neat. A twelve-mile transmission line has been constructed and all plant is electrically driven. Recently a new head-frame has been erected at No. 1 shaft. Good progress is being made in sinking the new shaft, No. 3.

The Errington mine is a noteworthy enterprise. The work is being carried on under the direction of Joseph Errington, a man whose activities in Canadian districts put him in the first rank as a builder of new industries.

According to a statement dated March 17, 1928, the shares of Treadwell-Yukon Company, owners of the Errington mine, are held as follows: 750,000 by Banker Hill and Sullivan, 330,000 by Alaska-Treadwell, 114,000 by Alaska Mexican, 148,225 by Alaska United, and 157,775 by individuals. The first two companies have advanced large sums for the work being carried on.

F. W. Bradley in a recent statement said that it would take time to develop this great ore-zone, and that it was necessary to accumulate mining experience in the habit of the ore-bodies. At No. 1 shaft three separate ore-bodies are being stoped on the 300 ft. level, but very little exploratory work is being done on this level, where ore in advance of immediate needs has been developed. On the 500 ft. level of this shaft a cross-cut is being extended, but it has not yet reached the veins. Approximately one million tons has been developed on the 300 level. At No. 2 shaft development is altogether at the 500 level. The main cross-cut was extended about 1,300 ft. and intersected four veins in a zone 480 ft. wide. The veins are respectively 61, 60, 65, and 49 ft. in width. These four veins are now being explored east and west and over their entire width. They consist of quartz-carbonate filling which has been in part replaced by the ore sulphides. Drifts are being extended and long-hole drills are being used to explore the vein widths from the drifts. At No. 3 shaft, 11,000 ft. east of No. 2 shaft, the shaft has been sunk to the 400 ft. level, a station cut, and the cross-cut started toward the vein, which is 1,140 ft. away. The milling problem has been solved, but there still remains the work of perfecting it; that is to say, making the best possible extraction under such operating conditions as will yield the maximum returns from the ore.

A feature of the Treadwell Yukon operation that is of special interest in Ontario is the fact that the mill products are lead concentrates, zinc concentrates, and copper concentrates. These products are at present shipped without further treatment in Canada, as there is no available customs plant. With the increased volume and variety of Ontario and Quebec mineral products additional refineries will soon be needed. It is not unlikely that Sudbury will in the near future have a copper refinery. An electrolytic zinc plant in Eastern Canada is also foreshadowed by developments at Sudbury and Rouyn.

Assay for Platinoids in Ores.—Two papers on platinum assay were presented at the November meeting of the Chemical, Metallurgical, and Mining Society of South Africa, by John Watson and H. R. Adam respectively. The paper by Mr. Watson is quoted here and that by Mr. Adam formed the subject of a precis last month.

Mr. Watson prefaced his paper by remarking that the word "platinoids" means platinum and the metals of the platinum group and must not be confused with certain trade names for alloys having some of the physical properties of platinum.

Presuming a fairly big sample is received it should first be crushed to pass through a sieve of 10 apertures to the linear inch and thoroughly mixed; then an average portion should be taken amply sufficient for assay purposes, and pulverized to pass through a finer sieve of at least 40 holes to the linear inch. When pulverized it should be mixed well.

A useful stock flux is prepared as follows :—

Dry Soda Ash (monocarbonate) .	3 lb.
Pure Assay Litharge . .	3 lb.
Fused Borax	1 lb.
Silver Chloride . .	1·5 gms.

In mixing the flux, it should be put through a sieve of 10 or 20 mesh, then the silver chloride powder added and all mixed thoroughly. If the same class of ore is being treated, the reducer can also be mixed in with the flux. A measured quantity of the flux is placed in a rice-bowl, 2 assay tons of the ore weighed off, then about 0·4 A.T. pulverized argol or other suitable reducer added. As the ore may vary in composition, it may be necessary, in the case of a norite or dunite to add pulverized silica and more soda. The use of sodium bicarbonate is antiquated and sodium carbonate, as dry as possible, should be used. The flux and ore are now mixed together in a Wedgwood mortar and transferred to a crucible, rinsing out the mixing bowl and mortar with a little soda or borax. The crucible should be of ample size. For 2 A.T. of ore the Boksburg pot 5¾ in. high. by 4 in. diameter at mouth may be used. The charged crucibles are placed in the furnace, using lids if necessary to keep out coal or coke while heating up. A fairly high temperature is required and the heating should be continued for some time, after quiet fusion is attained, before pouring into clean, greased moulds. C. W. Davis in his Technical Paper 270 published by the United States Bureau of Mines, recommends that after the fusion has become quiet the temperature should be raised somewhat higher than is the usual practice and the heating continued for about an hour. Mr. Watson considers that this is not necessary for platinum, palladium, and gold ; but that it may be if osmiridium is to be determined, and also that in this case cooling in the pot is preferable to pouring into moulds. When cool, the slag is detached from the beads, which are hammered clean, as in gold assaying.

Cupels, sizes 40 and 60, having been heated up beforehand, are now charged and the cupellation is carried through at a temperature considerably higher than for gold assaying. The amount of silver chloride used will give a residual bead about the size of a No. 4 shot (= about 50 mgms. silver). The silver acts as a collector and prevents loss through "flying and spitting", which is characteristic of some platinoids.

When the beads are sufficiently cooled they are detached from the cupel and flattened on a steel anvil, hammering until very thin. Beads from a rich platinoid sample are somewhat brittle, in which case the hammering must be done cautiously. Pure sulphuric acid, diluted to 90% strength, is used for parting. The flattened beads are placed, each in a porcelain crucible of 1½ in. diameter by 1 in. deep, and acid added to half fill them. These are heated over a hot-plate, or asbestos gauze, using a Bunsen burner, Primus stove, or electric heater, whichever is available. Rich beads will give a pink, or reddish, colour to the acid ; they should be watched carefully and removed as soon as evolution of SO_2 ceases, as palladium is more soluble than platinum. Those which show no pink colour may be allowed to fume for 15 minutes. In the case of very rich samples, the bead from 2 A.T. ore, may not part thoroughly, even after reinquarting with more silver. In such a case it is better to put through repeat assays, in duplicate, on portions of 0·50 A.T. ore with extra silver added, using also somewhat larger crucibles for parting, as they hold more acid.

After parting, the cups are allowed to cool somewhat, care being taken to exclude dust, etc. The strong acid is now poured off, carefully, using a seal tube or short glass rod. A porcelain basin may be used for receiving the acid, which may be poured into a bottle or other receptacle, labelled "strong". The residues are washed in the cups carefully and thoroughly, with distilled, or rain water, at least three or four times. The wash-water may be kept in one or more large bottles, labelled "weak". The cups are then dried by heating in an air-bath at a temperature of 120° to 140° F. (49° to 60° C.), for about 5 minutes. The colour of the platinoid residue will now show black ; if gold if present in the ore, it will also be shown in the cup. Sometimes an ore is given for assay for gold and/or platinoids. If the residue at this stage shows gold colour and no black, it will stand a higher temperature for annealing purposes before weighing. On at least one of the farms of Transvaal Platinum, Ltd., there was a deposit of gold. In making out the daily sheet of routine assays, it was the author's practice to state the results as "Platinoids and/or Fine Gold per Short Ton". As the platinoid residue is of a spongy nature, it occurred to him that it might retain an appreciable amount of free sulphuric acid. Two grams of these residues were well washed with clean, settled rain water and the washings tested in the usual way by pure barium chloride, showing 0·68% H_2SO_4 retained in the residue.

Alkaline iodides give a brownish-red colouration due to the formation of the less ionized Pt. I_6 radicle This colour test, using potassium iodide, is the one generally employed for the detection of platinum. In assaying prospecting samples, the assayer gets quite a lot showing, perhaps, a trace (unweighable) ; also, if a platinoid residue in a porcelain cup is overheated, it forms a stain.

As a ratio of 15 to 18 silver to 1 of platinum is used, the author keeps all so-called "spent" acid. When a sufficient quantity has accumulated, the acids are mixed in a large beaker, taking care to pour, gradually, the stronger (90%) into the weaker (wash-water) and not vice versa. Considerable heat is evolved. Coarse crystal common salt is added in excess, the contents of the beaker stirred well and allowed to settle. For stirring, a caoutchouc or ebonite rod is preferable to glass. When the supernatant liquid is clear it may be poured off ; the precipitated Ag Cl will be strongly acid. The precipitate is transferred to a stoppered Winchester, using a large funnel, and the bottle is filled with distilled or rain water, agitated well, when the precipitate will be found to settle quickly. The solution is poured off and the precipitate is washed again, three or four times, and it is then transferred to a porcelain evaporating basin. Settle, pour off close, add a few drops of methyl orange, then dilute ammonia in slight excess. Make just acid with dilute nitric acid (1 HNO_3 : 4 H_2O. Pour off excess water, dry gently on a warm plate, put through a sieve of 10 or 20 mesh and keep in a stoppered bottle of brown or blue glass. The recovered silver chloride has been checked, repeatedly, for platinoids and gold and always found to be free from such.

The author felt that the first lot of silver chloride recovered might contain some palladium. He

was then at the Transvaal Platinum property, near Naboomspruit. The ratio there was 10 of palladium to 88 of platinum. Doubtless a certain amount of that palladium is dissolved and gets in with the stock of spent acid. On precipitating as described, however, palladium does not appear to be carried down. He checked every lot of his recovered silver chloride and always found it to be free from all platinoids and gold. If palladium were present, it would easily be detected, owing to its solubility and colour.

The author does not deal in the paper with the separation or isolation of the platinoids and gold, as such matters will be the subject of many future papers before the society.

The Origin of the Great Rift Valleys, Kenya.—In the *Transactions* of the Geological Society of South Africa, vol. xxxi, 1928, Ernest Parsons reviews the existing theories of the origin of the Great Rift Valleys as summarized by J. W. Gregory and J. Ball of the Egyptian Survey. After carefully weighing the evidence afforded by his extensive geological survey of Coastal Kenya he comes to the conclusion that it would seem from a study of the earth-movements, which have affected the strata of the region, that the formation of the rift valleys must be attributed to the action of tectonic forces ; that these forces were compressional rather than tensional ; and that they were lateral pressures in the earth's crust similar to those stresses, which in other regions have resulted in the formation of folded mountain structures. It seems more than probable that these earth-forces were the result of the breaking up of Gondwanaland, which commenced in early Jurassic times and continued into the Kainozoic era. The formation of the unique orographical features of Africa instead of the formation of mountain structures must be attributed to similar, i.e. tangential forces, acting under different conditions, and not to exceptional types of earth-movement. It is generally accepted that one of the primary conditions necessary for the formation of folded mountain structures is that the area should have been one of recent heavy deposition, and contain extensive deposits in a relatively unconsolidated condition. Such were not present in this region, but it was an area of exceptional stability and consisting largely of rocks which had been thoroughly consolidated and had long formed a land area. Consequently, instead of rocks folding, they fractured and gave rise to reversed faults, which, with the subsequent vulcanicity and denudation, has given rise to the unique land-forms seen along the Rift Valleys.

SHORT NOTICES

Geology of Coal.—In his presidential address to the Section of Geology, Sixteenth Indian Science Congress, 1929, Cyril S. Fox discusses the origin and geology of the Indian coals. He holds that these are detrital sediments, some of which were deposited in fresh water and some in shallow sea-water.

Coal Mining in India.—In *Colliery Engineering* for February 29, C. Habberjam describes the method of pillaring and timbering in use in coal mines in India and also discusses the problems of spontaneous combustion and of de-watering.

Bauxite.—In *The Chemical Age* for February 16, G. Malcolm Dyson writes on the occurrence, types, and purification of bauxite, including the Bayer process.

Mining Subsidence Theories.—In the *Colliery Guardian* for March 1, is a paper read by E. Knox before the South Wales Institute of Engineers, Cardiff, on the subject of the subsidence of strata overlying coal seams as a result of mining operations.

Ore Genesis.—In *Engineering and Mining Journal* for February 23, Carlton D. Hulim continues the subject commenced in the issue of February 9.

Diamond Drilling for Oil.—At the meeting of the Institution of Petroleum Technologists, held on March 12, G. Heseldiu read a lengthy paper on drilling for oil with the diamond drill.

Geology of Great Slave Lake.—In the Canadian *Mining and Metallurgical Bulletin* for February Carl Lausen describes a geological reconnaissance of the eastern shores of this lake in North-West Territories.

Diatomite—Its Properties and Uses.—In *Report* No. 691 of the Federal Department of Mines, Canada, V. L. Eardley-Wilmot describes diatomaceous earth, shows its origin, and gives its uses, composition, and physical properties.

Kimberlite Pipes and the Constitution of the Earth's Crust.—In the *South African Journal of Science*, Vol. XXV, 1928, P. A. Wagner discusses the evidence of the Kimberlite Pipes on the constitution of the outer part of the earth.

Extension of Ore-Shoots.—In *Technical Publication* No. 164 of the American Institute of Mining and Metallurgical Engineers, H. Schmitt discusses the extension of ore-shoots and the possibility of predicting them when estimating reserves and considering the advisability of deepening mines.

Electrode Potential and Primary Deposits.—In *Technical Publication* No. 166 of the American Institute of Mining and Metallurgical Engineers, B. S. Butler and W. S. Burbank discuss the bearing of some of the geological and chemical relations of minerals on the sharp changes in both mineralogy and metal content of primary (or hypogene) deposits, which occur in numerous places, with change in depth.

Tin Deposits of Nigeria.—In *Bulletin Société des Ingénieurs Civils de France*, May-June, 1928, M. L.-F. Glaser describes the tin deposits of Nigeria and gives an account of methods of prospecting, working, and concentrating the ore.

RECENT PATENTS PUBLISHED

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

21,830 of 1927 (306,561). J. W. Hornsey, New York. The conversion of granular iron ores into granular iron by reduction with suitable reducing agents without involving a liquefaction, or a molten or sintering stage.

26,178 of 1927 (305,602). B. Laing and J. J. C. Brand, London. Improvements in or relating

to tanks, compartments, magazines, bunkers, or containers for inflammable or explosive liquids, or substances.

28,035 of 1927 (306,566). S. C. Smith, London. In this patent (which is a further improvement of the method described in The Magazine of November, 1928) a process is described for obtaining platinum concentrates from platiniferous ores carrying nickel, cobalt, and iron, by first producing a sulphide matte; then desulphurizing the matte, with or without first Bessemerizing it, by roasting; then reducing the roasted matte to produce a metal sponge, with or without previous leaching with acid to remove the bulk of the copper; then extracting the sponge with dilute acid so as to dissolve nickel and iron and to leave the platinum metals generally admixed with copper.

28,265 of 1927 (306,569). S. Robson, Avonmouth. A process for the production from sulphide ores, concentrates, and the like, of a porous material suitable for distillation in a retort for the recovery of zinc, and the simultaneous recovery of gases having a sulphur content suitable for the manufacture of sulphuric acid.

29,057 of 1927 (304,396). N. V. Philips Gloeilampenfabriken, Eindhoven, Holland. A process for coating a metallic or non-metallic body with rhodium, iridium, or nithenium according to which the body is heated in an atmosphere containing the volatile compound or compounds of the metal of metals.

30,242 of 1927 (305,712). I. G. Farbenindustrie A.G., Frankfort. Improvements in or relating to the process for the decomposition of chromium ore, and the manufacture of chromium compounds free from iron.

31,557 of 1927 (290,647). International Nickel Company, New York. Improved manufacture of nickel and nickel alloys.

32,020 of 1927 (281,338). F. L. Duffield, London. Describes a new ore-roasting furnace.

1,360 of 1928 (283,598). Demag A.G., Duisburg, Germany. Improvements in methods and means for filling in disused workings and the like in mines.

4,300 of 1928 (306,691). S. I. Levy and G. W. Gray, London. Improvements in and relating to the treatment of pyrites, especially from the point of view of the complete recovery of substantially pure sulphur and ferric oxide, and of non-ferrous metals in the form of chlorides.

7,992 of 1928 (304,639). Les Petits Fils de François de Wendel et Cie., Paris. Improvements in processes for the recovery of the tin contained in the residues of tin-plate manufacture.

12,284 of 1928 (291,004). Deutsche Gasglühlicht A.m.b.H., Berlin. Process of decomposing ores of zirconium and other rare earth metals, and of titanium.

15,013 of 1928 (301,859). Anglo-American Corporation of South Africa, Ltd., Johannesburg. Improvements in the solvent treatment of copper silicate ores.

19,258 of 1928 (293,392). J. C. Seailles, Paris. Improvements in process for manufacturing and purifying alumina.

21,175 of 1928 (306,787). National Processes, Ltd., London. Improvements in gas collection from blast roasting or sintering furnaces.

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.

Miners' Welfare Fund. Seventh Report of the Committee appointed by the Board of Trade to allocate the Fund, together with the Second Report of the Selection Committee appointed to administer the Miners' Welfare National Scholarship Scheme. 1928. Quarto, paper covers, 74 pages, illustrated. Price 1s. 6d. London: H.M. Stationery Office.

Transactions of the Geological Society of South Africa, Vol. XXXI, 1928. Quarto, paper covers, 167 pages, illustrated. Price £2 2s. Johannesburg: The Geological Society of South Africa.

Report of the Department of Mines, Western Australia, 1927. Paper covers, 308 pages, illustrated. Perth: Department of Mines.

Report by the Rt. Hon. W. G. A. Ormsby Gore, M.P., on his visit to Malaya, Ceylon, and Java during 1928. Octavo, paper covers, 166 pages with 3 maps. Price 4s. 6d. London: H.M. Stationery Office.

Metal-Mine Accidents in the United States, 1926. By William W. Adams. U.S. Department of Commerce, Bureau of Mines, Bulletin 292. Octavo, paper covers, 119 pages. Price 1s. Washington: Government Printing Office.

Summary of Progress of the Geological Survey of Great Britain, 1927, Part II. Octavo, paper covers, 110 pages. Price 2s. 6d. London: H.M. Stationery Office.

Annual Report, Mines Department, Tanganyika Territory, 1927. Octavo, paper covers, 14 pages. Dar-es-Salaam: Mines Department.

Silesia Revisited. By Lieut.-Col. G. S. Hutchison. Octavo, paper covers, 111 pages, illustrated. Price 2s. 6d. London: Simpkin Marshall, Ltd.

Outlines of Geology of Regions adjoining the South-Eastern Shores of Lake Victoria. By F. B. Wade. Octavo, paper covers, 20 pages and map. Short Paper No. 1, Geological Survey Department, Tanganyika Territory.

Lupa Gold Field. By D. R. Grantham. Octavo, paper covers, 6 pages, 2 maps. Short Paper No. 2, Geological Survey Department, Tanganyika Territory.

An Introduction to the Study of Ore Deposits. By F. H. Hatch. Cloth, octavo, 117 pages, illustrated. Price 7s. 6d. London: George Allen and Unwin, Ltd.

Geology of Gold. By E. J. Dunn. Cloth, octavo, 303 pages, illustrated. Price 35s. London: Chas. Griffin and Co., Ltd.

Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland, 45th annual issue. Cloth, octavo, 420 pages. Price 18s. London: Charles Griffin and Co., Ltd. This valuable publication contains a list of all the Scientific and Learned Societies of Great Britain and Ireland, together with a list of the lectures and papers read before the same during the Session 1927–1928.

COMPANY REPORTS

Government G. M. Areas.—The ore milled for 1928 was about the same as for 1927, being 2,383,500 tons, against 2,395,000 tons. The gold output was 1,080,122 oz., value £4,588,069, or 38s. 6d. per ton, working costs being £1,977,779, or 16s. 8d. per ton, and working profit £2,610,290, or 21s. 11d. per ton. Dividends totalling 90% absorbed £1,260,000, whilst £1,434,176 went to the Union Government as their share of the profits. The ore reserves at the end of the year were estimated at 10,973,000 tons, value 8·9 dwt. over a stoping width of 65 in.

New State Areas.—Owing to an adequate labour supply for the greater portion of 1928 the company was able to crush 908,000 tons, or 41,000 tons in excess of 1927. The gold output was 381,022 oz., value £1,618,479, or 35s. 8d. per ton. Working costs were £954,944, or 21s. per ton, and working profit £663,535, or 14s. 7d. per ton. Dividends totalling 12½% absorbed £189,255 and £357,191 went to the Union Government as their share of the profits. The ore reserves at the end of the year were estimated at 2,678,000 tons, value 8·7 dwt. over a stoping width of 51 in.

Witwatersrand Gold.—The report for 1928 states that 630,000 tons was crushed for 132,477 oz. of gold, value £564,041. Working and general expenses totalled £552,276 and a dividend of 2½% absorbed £11,741. The ore crushed was greater than in 1927 by over 54,000 tons, which enabled a reduction of 6d. per ton to be made in costs, but the grade of ore was lower by 1s. 1d. per ton, so that the overall profit on mining operations was down £16,955. The ore reserves at the end of the year were estimated at 404,000 tons, value 5·2 dwt. over a stoping width of 53 in.

Modderfontein Deep Levels.—For last year the tonnage milled constituted a record, being 530,300 tons, as compared with 529,300 tons for 1927, the previous highest figure. The gold output was 280,246 oz., value, including receipts from osmiridium, £1,192,978, or 45s. per ton. Working costs were £419,373, or 15s. 10d. per ton, against 15s. 5d. for 1927, and working profit £773,605, or 29s. 2d. per ton of ore milled. Dividends totalling 135% absorbed £675,000. The ore reserves at December 31 last totalled 3,000,000 tons, value 9 dwt. over a stoping width of 79 in., a decrease of 560,000 tons, the value being 0.1 dwt. more, but the width 1 in. less.

Geduld Proprietary Mines.—The ore crushed last year at 979,000 tons compares with 983,500 tons for 1927, the gold output being 305,967 oz., value £1,298,758, or 26s. 6d. per ton milled. Working costs were £813,095, or 16s. 7d. per ton milled, the same as for 1927, whilst the working profit was £485,663, or 9s. 11d. per ton milled, this being down 1s. 3d. per ton milled, due to the decrease in value of the ore reserves. Dividends totalling 33¾% absorbed £448,218. The ore reserves were more than maintained, although less development was done, being at the end of the year 6,100,000 tons, value 6.5 dwt. over a stoping width of 60 in., an increase of over 80,000 tons in quantity and 0.1 dwt. in value, although the stoping width is lower by 2 in.

Langlaagte Estate and Gold Mining.—The working profit for 1928 showed a substantial improvement, due mainly to a higher revenue per ton, the increase being £41,749 in excess of 1927 From the 970,000 tons crushed 303,132 oz. of gold was recovered, the total revenue, including receipts from osmiridium and other sources, being £1,309,292. Working and general expenses were £1,008,820 and dividends totalling 15% absorbed £227,975. The ore reserves at the end of the year were estimated at 1,567,500 tons, value 7·1 dwt. over a stoping width of 42 in.

Van Ryn Deep.—Owing to an increase of 1s. 4d. per ton in the working costs, the working profit for 1928 was down £42,434 as compared with 1927, this being due to the necessity of mining a greater area to maintain the tonnage output and to a larger development programme. For the year 759,000 tons was milled for 300,367 oz., value £1,275,876, or 33s. 7d. per ton milled, the working costs being £734,364, or 19s. 4d. per ton milled, and the working profit £541,512, or 14s. 3d. per ton milled. Dividends totalling 40% absorbed £478,757. The ore reserves at the end of the year were estimated at 3,110,700 tons, value 7·4 dwt. over a stoping width of 50 in.

Randfontein Estates.—The report for 1928 states that 2,500,000 tons was crushed for 567,707 oz. of gold, the total revenue, including receipts from osmiridium and other sources, being £2,446,210. Working and general expenses amounted to £2,174,589, whilst £249,276 was appropriated for capital expenditure and redemption of debentures. The unappropriated balance forward was £180,306, against £217,990 at the end of 1927. The ore reserves at December 31 last were estimated at 4,196,800 tons, value 5·8 dwt. over a stoping width of 42 in.

Crown Mines.—The report for 1928 states that the tonnage milled equalled the record established in 1926, and exceeded that of 1927 by 103,000 tons. Last year 2,611,000 tons was treated for 857,733 oz., value £3,621,240, or 27s. 9d. per ton, receipts from silver and osmiridium bringing the total to £3,634,089, or 27s. 10d. per ton. The working costs were £2,664,996, or £1 0s. 5d. per ton milled, leaving a working profit of £969,093 or 7s. 5d. per ton milled. The increased tonnage milled for the year was balanced by a decline of 4d. per ton in the working profit, which left the total working profit practically unchanged. Dividends totalling 55% absorbed £507,684. The ore reserve at the end of the year totalled 10,962,250 tons, value 6 69 dwt., an improvement of 737,510 tons and 0 2 dwt. respectively. The increase in the ore reserves has been chiefly due to the acceleration of reef development in advanced and widely extended sections of the Main Reef Leader. The supply of native labour is stated to have shown little improvement, being considerably below the company's requirements.

Mysore Gold Mining.—Last year 217,199 tons was milled, the total output of gold from all sources being 116,435 oz., value £497,349. After deducting royalty and refining charges and adding interest, rents, etc., the total income was £479,247. Working costs were £301,352, the profit on the year's operations being £177,895. Dividends totalling 22½%, or 2s. 3d. per share, have been paid, the same as for 1927. The available ore reserves at the end of 1928 were estimated at 569,617 tons, an increase of 12,417 tons as compared with the end of 1927.

St. John del Rey.—The report for 1928 states that 153,100 tons was crushed for 97,576 oz. gold, value £411,711, whilst bullion value £13,508 was recovered from old mine workings and exploration. Working costs in Brazil were £296,727 and, after deducting development and London expenses, there was a profit of £87,934, or £27,646 in excess of 1927. A final dividend of 1s. 6d., less tax,

is recommended, making with the interim dividend 10 per cent. for the year on the ordinary shares, the carry forward, after transferring £20,000 to capital works account, being £41,293, against £41,061 brought in. The ore crushed in 1928 shows an increase of 4,200 tons as compared with 1927, the yield per ton being 2s. 7½d. per ton higher, whilst there was a decrease of 1s. 3½d. a ton in working costs. With regard to development—on which a larger amount was spent last year—there being some doubt as to whether the lode reached at horizon " 25 " in April was the main lode, explorations were carried out which resulted in the discovery of another ore body to the north, which is said to resemble the main lode both in appearance and value. In view of the delay in proving the main lode at horizon " 25 " no decision has yet been come to as to the construction of the direct route which will be necessary if the mine is to be worked at greater depth. Exploration south-east of the " 22 " horizon has also intersected an ore body of high grade, making a valuable addition to the ore reserves.

Gopeng Consolidated.—The report for the year to September 30 last shows that 1,959,000 cubic yards of ground was treated for 748 tons of tin concentrate, as compared with 2,132,900 cubic yards and 823 tons for the previous year, the decrease being due to shortage of water owing to the rainfall being much below the average. The yield per yard was 0·85 lb., as compared with 0·87 lb. The revenue from the sales of concentrate was £101,049 and other items brought the total receipts to £101,788. The profit was £71,873, out of which £64,312 has been distributed in dividends totalling 3s. 3d. per share, whilst £10,000 has been written off pipelines and mine equipment. Prospects for the current year are stated to be excellent and with better conditions as to rainfall and water supply returns are expected to be above the standard of the past year.

South Crofty.—For 1928 the ore crushed was 74,039 tons, 1,307 tons in excess of the preceding year, but the black tin recovered was about 12 tons less at 795½ tons, value £111,876, whilst the arsenic recovered was 279 tons, value £6,437, and the wolfram 10½ tons, value £501. The profit for the year was £16,510, from which dividends totalling 10% have been paid, absorbing £10,400. The company's profit was seriously affected by the lower price ruling for tin during the year. Although the metal content of the black tin produced for 1928 was slightly higher than in 1927 and smelting charges were considerably lower, the net value of the tin recovered was £29,437 less. The costs at the mine were £1 7s. 10d. per ton crushed.

Mason and Barry.—The report for 1928 states that the quantity of ore broken and raised was 184,868 tons, against 168,976 tons for 1927, the shipments (including ore from the Cementation Works) amounting to 201,289 tons, against 207,668 tons. The profit on the year's working was £35,342. It is proposed to pay a dividend of 20%, which will absorb £37,034, so that the carry forward for 1928 at £22,322 is down £1,692 as compared with 1927.

DIVIDENDS DECLARED

Anglo-Continental.—1s. 3d., less tax, payable March 30.

Anglo-French Exploration.—2s., less tax, payable April 25.

Arizona Copper.—40s., payable May 21 (liquidation distribution).

Broken Hill South.—1s. 6d., less tax, payable May 15.

Central Provinces Manganese Ore.—3s., free of tax, payable April 11.

Champion Reef.—1s., less tax, payable April 20.

Gopeng.—9d., less tax, payable April 6.

Idris Hydraulic.—3d., less tax, payable March 27.

Jagersfontein, New.—2s., less tax, payable April 4.

Jelapang Tin Dredging.—6d., payable March 27.

Kinta Tin.—3d., less tax, payable March 28.

Kundang Tin Dredging.—6d., payable March 27.

Lampa.—6d., less tax, payable March 18.

Larut Tin Fields.—6d., payable March 27.

Mason and Barry.—4s., less tax, payable April 25.

New Primrose.—3s. (first liquidation distribution), payable April 9.

Ooregum.—Pref. and Ord., 1s., less tax payable April 27.

Pengkalen.—Pref. 9d., less tax, payable April 25.

Ditto.—Ord., 3d., less tax, payable April 25.

Premier Diamond.—Pref., 6s. 3d.

Sinai.—Pref. and Ord., 1s. 9d., less tax, payable April 12.

Sungei Besi.—3d., less tax, payable March 26.

Sungei Way.—3d., less tax, payable April 26.

Tanjong Tin.—3d., less tax, payable March 28.

Tharsis.—4s., less tax, payable May 10.

Transvaal G.M.—6d., less tax, payable May 2.

Tronoh Mines.—4½d., less tax, payable March 27.

Union Corporation.—3s. 6d. less tax.

Wankie Colliery.—6d., less tax, payable April 3.

NEW COMPANIES REGISTERED

Brunler Furnace (Foreign).—Registered March 20. Capital: £15,000 in 7,650 " A " Ordinary and 7,350 " B " Ordinary shares of £1 each. Objects: To acquire and deal with certain inventions and processes applicable for the melting and working of minerals and metals and the manufacture and concentration of chemicals and other matters, etc. Directors: O. Brunler and J. K. K. Paterson. Office: 35, Walbrook, London, E.C.

Consolidated Radium.—Registered March 11. Capital: £25 in £1 shares. Objects: To acquire mines, mineral or other properties, to prospect for, work and develop pitch blende, uranium, radium mines, etc.

Great Northern Gold Dredging.—Registered March 14. Capital: £93,000 in 90,000 " A " shares of £1 and 60,000 " B " shares of 1s. Objects: To adopt agreement with Anglo-Eastern Tin, etc.

Lisburne Base Metals Recovery.—Registered March 6. Capital: £18,000 in 2s. shares.

Viborita Gold Mines.—Registered March 2. Capital: £130,000 in 5s. shares. Objects: To acquire the undertaking and assets of the Alluvial and General Mining Co. Directors: Sir Henry P. Harris (chairman St. John del Rey Mining Co.), Right Hon. R. W. H. O'Neill, M.P. (chairman Frontino and Bolivia (South American) Gold Mining Co.), C. A. Bolton (director G. T. Holloway and Co.), A. B. Coussmaker (director Johnson Matthey and Co.), F. S. Hooker (chairman Mincing Lane and General Trust). Office: 206, Gresham House, Old Broad Street, E.C. 2.

West African Dredging.—Registered March 9. Capital: £2,500 in 2s. shares. Objects: To carry on the business of dredgers and searchers for gold, tin, iron, and other metals, etc.