The Mining Magazine

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EDITORIAL

SOME consternation has been caused in the Royal Duchy by the disclosure of clauses in the County of Cornwall Bill (1929) which may seriously hamper the already suffering mining industry of Cornwall and some details of which are given by our Camborne correspondent. Let us hope they may have "a happy issue out of all their afflictions."

"TIN: Salient Facts and Opinions" is the title of a little brochure written by J. A. L. Gallard and Murray Stuart and published by Mining Publications, Ltd. (Proprietors of THE MINING MAGAZINE), at the price of 2s. 6d. It explains to the uninitiated something of how tin is found and what are its principal uses and likely future demand.

THE next meeting of the Institution of Mining and Metallurgy on March 21 will be devoted to a symposium on geophysics. Papers will be read by Capt. H. Shaw, Mr. E. Lancaster-Jones and Dr. W. F. P. McLintock, Mr. A. Broughton Edge, and Professor A. O. Rankine respectively dealing with magnetic, gravitational, electrical, and seismic methods. The succeeding meeting on April 18 will be devoted to the discussion thereof.

A new expedition to the Antarctic is being organized for the end of this year under the leadership of Sir Douglas Mawson, professor of geology and mineralogy in the University of Adelaide, who accompanied Sir Ernest Shackleton in 1907 and led the 1911–1914 expedition. The British Government is providing the ship *Discovery* and the Australian Government will provide the necessary funds, while the Government of New Zealand is also contributing. Use of a new continuous-recording sounding device is to be made which will considerably facilitate progress. Where conditions permit, it is proposed to examine outcrops ashore for minerals.

"BIGGER and better than ever" is an obvious epithet to apply to this year's British Industries Fair, reference to which is made elsewhere in this issue. This annual event, which is becoming one of increasing importance, is organized as to the London section by the Department of Overseas Trade and as to the Birmingham section by that city's Chamber of Commerce. Perhaps the most outstanding feature of the 1929 fair has been the comment its occurrence has occasioned from our "Ambassador of Empire," in which he levels no uncertain criticism at British manufacturers' selling methods in foreign markets—a criticism which appears to have met with a considerable measure of endorsement from several of our captains of industry. For our part, we would allude only to the poor representation in the mining section, although in other sections of the fair there was much to interest the mining community among the displays offered by power-plant and steel manufacturers.

Imperial College Annual Report

The twenty-first annual report of the Governing Body of the Imperial College of Science and Technology, covering the twelve months to July last, is invested with special significance in virtue of its appearance at a time which can only be regarded as critical in the history of the College. In the early part of the report announcement is made that instead of extending the existing Union building by the addition of two more storeys—which was the scheme indicated in outline in the previous annual report—it is now proposed to erect a new building to meet the growing needs of the Imperial College Hostel and the Imperial College Union. The position for the proposed new building is the vacant front part of the site comprising the two Botany buildings, the Hostel and Union, and adjoining buildings. While a two-storeyed building occupying the whole of the available space would suffice for the present requirements of the extended Hostel and Union, it is pointed out that the ultimate building should comprise at least five storeys, if the site is not to be wastefully used, and it is, therefore, proposed to erect the complete shell of such a building, and to finish internally the two floors immediately required, leaving the remaining floors to be completed as the necessities of the work of the College require. As this project involves the expenditure of £30,000 in excess of that on the partial scheme, its realization must depend upon additional financial help being forthcoming.

The second point of interest in the report is the announcement of important changes in the regulations governing examination and

re-examination in the finals work for the A.R.S.M., and the A.R.C.S., involving a modification of the Huxley system, the Board of Studies having recommended that the practice should be brought into line with that associated with the award of the Bachelor's Degree in London University. The present system—designated "tandem" and initiated in the time of the late Professor Huxley—whereby examinations follow each course of study, is to continue, with the difference that in future a unit of result will be one complete year's work rather than a single subject. Thus failure to pass in a particular subject will not be so easily remedied as heretofore!

On the subject of research, it is of interest to note that the amount done during the year, if this may be judged by the numbers engaged therein, shows a very considerable increase, and in one department the necessity for additional accommodation has to be faced.

Turning now to the section of the report which is of pre-eminent importance—namely, that dealing with the position of the College *vis-à-vis* London University—we find the possibility of a severance of connection foreshadowed. The state of affairs appears to be somewhat as follows: A Departmental Committee of the Board of Education was set up some time ago to inquire into and make recommendations for an alliance of the Imperial College and London University. Certain proposals in that Committee's report were criticized by the Governing Body of the College (in their report for the year ending July, 1926) as being detrimental to parts of the University without corresponding benefit to the whole. In the report now under review it is disclosed that representations have been made to the University Commissioners arising out of the first draft of Statutes prepared by them, affecting both the constitution of the proposed new Council (or Court) and the conditions under which the College might become or remain a school of the University.

With regard to the first consideration, a larger council is asked for, and one, moreover, constituted with fewer members of the Senate upon it. As to the second, it is maintained that the special conditions of the Imperial College justify a demand that it should be exempted from two of the usual stipulations concerning schools of the University—namely those referring to the receipt of grants from public bodies, otherwise than through the Council, and to the appointment of professors and other staff grades. Later Statutes issued by the Commissioners indicate that no variation in the main findings of the original committee has been admitted, in spite of the representations alluded to above, and the Governors' report consequently concludes with the following significant lines: "It will accordingly be our serious duty later to consider and to determine whether or not the Imperial College shall become or remain a part of the University."

It is difficult, if not, indeed, unwise, at this stage to comment on the matter, yet we may be permitted the following observations. From the student point of view, we take it that a Bachelor of Science Degree is sought after for two very good reasons: First, because present-day prospective employers, frequently through ignorance, demand of a scientifically trained man that he should possess the only distinction recognized in the world at large, and, secondly, because it is a necessary preliminary to higher Degrees of London University. The former is largely a matter of prejudice; that the latter should be so is surely somewhat anomalous, in view of the fact that the University admits that the College's course and examinations qualify for graduation. With these remarks we will leave the questions for wiser heads, trusting that in the disagreement between the two corporate bodies the interests of the individual student will not be overlooked.

British Metallurgy

At the February meeting of the Institution of Mining and Metallurgy the discussion was resumed and concluded of Dr. Cullen's paper, referred to in some detail last month, when a general account of the views of members was promised. Professor Truscott drew attention to the 5,000 non-technical directors of mining and metallurgical companies and thought that science should play a greater part in supreme management. This was, in fact, the principal note sounded in the whole discussion. Mr. G. C. Klug for example, put forward specific proposals for the formation of committees of this and other like institutions, whose avowed object would be a contribution to the movement for peace in industry. In his opinion there was nothing wrong with the workman, either here or in Australia, but he questioned whether the man was being properly led. He also considered the power position in the

light of modern developments to be entirely satisfactory.

Dr. R. S. Hutton, who is the Director of the British Non-Ferrous Metals Research Association (under the wing of the Department of Scientific and Industrial Research), pointed out that advantage had not been taken by mining companies of facilities offered by his department for investigation of problems. He also described a certain German works where the apparent practice was the scrapping of elderly directors, much as they scrapped out-of-date machinery! Referring to the development of extra-territorial mining propositions, he made the interesting suggestion that we did not (as other countries do) gain sufficient advantage to employment at home by conditions as to purchase of equipment or as to the disposal of the products of the enterprise. This view we emphatically endorse.

The distinction between Metallurgy I and II, which we defined last month, was referred to by Dr. Sidney Smith. He dealt with what he regarded as several inconsistencies in the paper and remarked there was a good deal of indefiniteness, and thought it would have to be less of a collection of random statements and more of a coherent scheme before its author dare present it to the 5,000 directors mentioned by Professor Truscott. Admitting the difficulty of making constructive suggestions, he thought the Empire must be regarded as a unit. Thus a particular metallurgical industry lost to the home country might be a gain to one of her Dominions. Mr. D. A. Bremner found the introduction of an economic paper like this very opportune and demanded somewhat insistently that the technical brains should play a bigger part in the control of industry. He pleaded, however, for caution and further discussions of this character before a practical plan was formulated.

Foreign competition and how to meet it by reducing charges, in which the chief items were freight, dock and town dues, and handling, was specifically dealt with by Mr. W. Pellew-Harvey, who indicated that some co-operation with transport and port authorities seemed to be necessary. Professor B. W. Holman confined his remarks to directorship and transport. He suggested that many mining men were ignorant of economics, but expressed the view that this was no reason why one such should not serve on the board of all mining companies. As to transport, the trouble, he thought, was that our inland waterways, which 300 or 400 years ago were the finest in the world, had fallen into disuse, whereas ores and concentrates were ideal traffic for them. On the contrary, our railway system was saddled with heavy capital expenditure on land and bore the added burden of high taxation.

At the resumed discussion Professor Truscott, by way of introduction, said the position of the industry was largely due to inadequate equipment and to the small scale of operations, exemplifying his remarks by reference to copper ores. Mr. F. W. Harbord also took copper as his text and pointed out that a control of raw materials (which in the widest sense includes power supply) was an essential for the development and maintenance of any particular industry; hence the American position with regard to that metal. He also dealt with transport and the need for better understanding of economics if the technical man wishes to assume control. On the subject of scholarships, to which allusion had been made by various speakers, he thought those of the post-graduate variety were the real need.

As one of the much-discussed non-technical directors, Colonel Cross Brown intervened in the discussion at this stage with the suggestion that technical and non-technical might work as separate entities, but in close co-operation in a manner analogous to the combatant and non-combatant forces in the army. He also supported the formation of an association of non-techincal mining directors, among the functions of which would be inquiry into mining laws, labour, sanitation, transport, accounting, and such-like.

Sir Thomas Holland began by talking about gardening! Excusing the Council for permitting these excursions into the realms of economics, he suggested that such behaviour was no more reprehensible than that of the diligent gardener who took occasional peeps over the fence—peeps which were, moreover, not into his neighbours' but common property and fallow land at that. Like Dr. Smith, he found several inconsistencies in the paper and took the author somewhat seriously to task for them. He thought that the question was best dealt with by committees of experts who would examine the matter from the point of view of mineral resources within the Empire, and contingent smelter and other treatment plants, transport, power and so on—in fact, on similar lines to those suggested in his own paper some two years previously.

In the opinion of Mr. J. B. Richardson the lack of canals was compensated for by a long coastline with many harbours. He also considered that copper, lead, and zinc might still be profitably mined at home, and alluded to the hostile attitude of the agriculturist because of river pollution and other evils supposed to be inseparable from mining and metallurgical operations, adding: "Almost the first word a baby farmer learned to lisp was 'compensation'"!

In a short verbal reply Dr. Cullen made the interesting announcement that he had been asked to present the facts and figures in his paper, which had remained unchallenged by members, before a Parliamentary Committee, as a result of which an important metallurgical works might come into being.

Before leaving this subject, we would add that the question of the position of the technical man in industrial conferences has of late been somewhat widely discussed in the daily Press *à propos* the Melchett-Turner conference and we hope to take an early opportunity of dealing further with this aspect of the matter.

Developments in the Use of Coal

As long ago as February, 1924, and October, 1925, we referred in the MAGAZINE to the importance of the subject of pulverized fuel and to the obvious advantages possessed by low-temperature semi-coke for use in this form. From time to time we have referred to the subject since. Some months ago we were informed that the Department of Scientific and Industrial Research was to have the use of an old Naval sloop for experimental work with pulverized fuel. We now learn that the Department has decided it does not require her, as it is found that, with the general increase in the commercial use of this fuel, all questions which could be tried out in a small and old warship have already been answered. It will probably come as a surprise to some of our readers to learn that so much progress has been made in this branch of fuel technology, and it will probably come as still more of a surprise to learn that in 1928 over twenty-five million tons of coal were consumed in America in powdered form. Even in America, however, as Dr. C. H. Lander pointed out in his Cantor Lectures delivered before the Royal Society of Arts, it can be said that the use of pulverized fuel is still in its infancy, a remark which applies even more to Great Britain.

To turn to the question of the application of the use of fuel of this type to marine engineering, several ships are running successfully which burn powdered coal, and the announcement has been made recently that a merchant ship is to be built and fitted to burn pulverized fuel under the Brand System—the fuel being either anthracite or low-temperature semi-coke. Elsewhere in this issue we publish a description of that system.

There have been several obstacles in the way of storing pulverized fuel on ships hitherto. In consequence it has been necessary to crush the coal on board shortly before the product is used. The crushing plant is frequently very noisy, it occupies space, and all the old disadvantages of coaling ship still remain. It seems probable, however, that by using low-temperature semi-coke instead of raw coal this difficulty may be overcome. On this point Dr. Murray Stuart, in his recent book "Low-Temperature Carbonization Explained," says: "A great difficulty from the point of view of shipping is that pulverized raw coal is liable to spontaneous combustion, and therefore it cannot be stored in a pulverized form. Low-temperature semi-coke puts an entirely different complexion on this question, since it is not ordinarily liable to spontaneous combustion, and therefore can be stored, and it is quite possible that the near future may see pulverized low-temperature semi-coke being pumped into bunkers on ships and handled and burnt in practically the same way that fuel-oil is now handled and burnt."

The ordinary low-temperature distillation process deals with either lump or slack coal, and the semi-coke would have to be crushed, for use as a pulverized fuel. Attention has however, already been directed in the MAGAZINE to one process—the McEwen Runge—which is designed to be an integral part of a system of pulverized fuel and which actually treats the raw coal after it has been crushed. From the point of view of powdered semi-coke such a proceeding has many advantages—for instance, the actual time of treatment is considerably less than if lump coal is being treated and therefore a larger throughput is possible, and it seems likely that a process working in this way may have the advantage when pulverized low-temperature semi-coke is the *desideratum*.

REVIEW OF MINING

Introduction.—The improvement noticed since the commencement of the year in the coal and iron industries has continued during the past month, although it has been retarded to some extent by the fear of dear money and the pending General Election. Copper has continued to forge ahead and tin has been well maintained, notwithstanding the increase in the visible supplies, whilst there has been little change in other metals.

Transvaal.—The output of gold on the Rand during February was 778,559 oz. and in the outside districts 36,725 oz., making a total of 815,284 oz., as compared with 840,344 oz., 36,108 oz., and 876,452 oz. respectively for the previous month. The natives employed at the gold mines at the end of the month totalled 196,150 as compared with 192,526 at the end of January.

The New Consolidated Gold Fields are now the owners of Soviet House, Moorgate—formerly the headquarters of Arcos—and they will be entering into occupation as soon as the necessary alterations have been carried out.

The profit of the Tweefontein Colliery for 1928 showed an improvement on the previous year, being £15,214, as compared with £12,977. The result is that in addition to the 10 per cent., the amount distributed in 1926 and 1927, the ordinary shares will on this occasion also receive a bonus of 2½ per cent.

With a view to providing the necessary funds for proceeding with the sinking of a new shaft the Daggafontein shareholders are to be offered 259,441 shares, in the proportion of one new share for each two shares held, at 22s. 6d. per share. The issue is underwritten by the Anglo-American Corporation of South Africa, who are also subscribing for a further 49,552 shares at 22s. 6d., so that £340,320 will be provided, sufficient, with the funds in hand, to finance operations till the shaft is down to the reef, which it is estimated will be struck at a depth of about 3,800 ft. by the end of 1930, by which time the funds available under the existing options will be adequate to bring the property to the producing stage.

Although Dr. Malcolm Maclaren's report on the Sub Nigel indicates that it will be necessary to reduce the grade of the ore sent to the mill and incur extra expenditure on exploratory work, he states that as the result of his recent examination he has come to the definite conclusion that the prospects for the continuation and repetition of the Sub Nigel pay shoots on the dip below the existing workings are extremely favourable. Unless a new rich shoot is found, however, he considers inevitable the reduction of the grade of ore to 18 dwt. With a couple of years' exploratory work—the extra cost of which is estimated at about £140,000—the position is expected to show considerable improvement. As Dr. Maclaren observes, with three years' ore reserves in the mine the position is really not unsatisfactory.

The decision of the General Council of the South African Mine Workers' Union to remove the colour bar from its constitution is calculated to give rise to some awkward questions. Its action is probably due, not not only to the recent intimation of the Government that it intended to delete the colour bar against Cape and other coloured workers, but also to the fact that the coloured workers' organization has applied for registration, it being evidently felt that it will be better to take them into the present union than have a separate body. The mining industry generally is in no way responsible for the decision of the General Council of the Workers' Union, recognizing the difficulties that are likely to be encountered if and when the natives become full members of the white miners' union.

Rhodesia.—The gold output of Southern Rhodesia for January was officially reported at 46,231 oz., as compared with 44,772 oz. for December. The number of producers was 119. Other outputs for January were: Silver, 6,031 oz.; coal, 113,927 tons; chrome ore, 20,446 tons; asbestos, 3,573 tons, and mica, 13 tons.

As the reduced ore reserves have necessitated a reduction of the Gaika tonnage from 7,000 to 5,000 tons a month, the directors point out the necessity of conserving the company's resources and not paying an interim dividend at the present time, so as to be able to carry through the development programme they have in hand.

It is proposed to increase the capital of the Luiri Gold Areas from £60,000 to £200,000, by the creation of 560,000 ordinary shares of 5s. each, as, in order to secure from the Chartered Company rights over three areas covering 184 square miles until the end of 1934, it is stipulated that not less than £3,000 per annum should be expended on prospecting during the period mentioned.

The report of the British South Africa Company for the year to September 30 last showed a net profit of £569,920, of which £550,269 has been distributed in dividend and bonus, amounting together to 1s. 6d. per share. It is stated that the value of the company's interests as mineral owners continues to grow in importance and this was emphasized at the meeting, not only by the chairman, but by Sir Edmund Davis, who expressed the opinion that Northern Rhodesia would ultimately become one of the great copper-producing centres of the world.

In his report for the three months to December 31 last the general manager of the Roan Antelope states that the drilling results for the period have been most satisfactory. Drill holes at wide intervals were completed through the ore at various points over a distance of more than 15,000 ft. along the strike of the mineralized beds, the ore occurrences being remarkably uniform in grade and the widths varying from 9½ ft. to 47 ft. The directors point out that although this drilling does not give sufficient information on which to base ore reserve calculations, in excess of the thirty million tons already estimated, it does prove the existence of commercial ore for a distance of 6,000 ft. beyond the area in which the ore reserves have already been calculated.

Cape Colony.—A new company is said to be in course of formation, with a capital of a million sterling, of which a fifth will be working capital, to take over the manganese and asbestos rights and plant of the Union Manganese Mines and Minerals, Ltd., the purchase consideration being fixed at £225,000.

Nigeria.—Although on one section of the property work was interrrupted by floods, the Northern Nigeria (Bauchi) output for the December quarter equalled that for the preceding three months—450 tons. On lease 240 drilling is stated to have proved 482 tons averaging 1·27 lb., whilst the Kwall Falls power plant is reported to have continued to run well.

Western Australia.—The report of Dr. Stillwell, who has recently made a geological survey of the Kalgoorlie goldfield, states that the southern limits in depth of the western lodes have not yet been reached, and the main hope of the future discovery of payable ore relates to the ground to the south and west of the main mining area.

The agreement between the Lake View and Star and the Golden Horse Shoe, under which the former will acquire the mine, plant, and certain other assets of the latter, met with the approval of the shareholders of the respective companies at their meetings last week. The purchase price is £180,000 in 900,000 fully paid Lake View and Star shares, the nominal value of which is 4s., to meet which the capital of the Lake View and Star is to be raised from £360,000 to £540,000. At the Lake View and Star meeting Mr. J. A. Agnew, who presided, dealt in a comprehensive and lucid manner with the position of the two companies and, thanks to his local knowledge and technical ability, was able to make clear a number of points which may previously have appeared a trifle obscure to the shareholders.

New Guinea.—Cabled reports as to developments on the various areas on which the Ellyou Goldfields Development Corporation are working continue to be of a satisfactory character, several lodes of good width and high assay value having been met with.

India.—It is some time since there was any trouble from rock-bursts in the Indian mines. Towards the end of last month, however, the Mysore reported a rock-burst in the Ribblesdale section, resulting in the death and injury of a number of Indians, which is to be regretted.

Malaya.—It is officially stated that the total output of tin in the Federated Malay States for 1928 amounted to 61,935 tons, valued at $118,804,747, which established a record. Whilst in 1923 the F.M.S. produced 29·1 per cent. of the world's output, last year it rose to 33·4 per cent. In 1910 the European mines are reported to have produced 22 per cent. and the Chinese 72 per cent., whereas for last year the percentages were 49 and 51 per cent. respectively, whilst for the first month of this year the figures are given as European 59 per cent. and Chinese 41 per cent.

The Malaysiam Tin, Limited, is among the latest companies to make its appearance. The capital is £250,000, in a million shares of 5s. each, of which 540,000 have been

issued. Four of the five directors are on the board of the Perak River Hydro-Electric Power Company, the fifth being managing director for the East of the Siamese Tin Syndicate, whilst Messrs. Pellew Harvey and Co. are the consulting engineers. The company's three tin-bearing properties are at Tambun, 6½ miles from Ipoh, and as they adjoin it is proposed to work them as one mine with monitors and hydraulic elevators.

Canada.—At the annual convention of the Canadian Institute of Mining and Metallurgy, which is being held this year at Winnipeg, Mr. John Bracken, the Premier of Manitoba, in welcoming the delegates, drew attention to the growth of the mineral industry which had followed railway construction in Ontario. As he pointed out, twenty-five years ago the mineral output of that Province was 14 million tons, whereas it was now over 100 million tons, and, after referring to Manitoba's present production of 4 million tons, asked: Who can predict its productive value in another quarter of a century?

The Mining Corporation of Canada is acquiring a 35 per cent. interest in a company which is to be formed to take over a group of silver-lead-zinc properties situated near Field, British Columbia. The properties are on the main line of the Canadian Pacific Railway and a fair amount of development work is reported to have been done, with satisfactory results. It is proposed to erect a mill with a capacity of 100,000 tons per annum.

It is proposed by legislation to give the Minister of Mines of British Columbia increased power in dealing with fraudulent promotions. No hard and fast rule is to be laid down in the matter, but among other things the Minister will have power to give notice in the public interest if the conditions surrounding a promotion are not satisfactory. There are many other places besides British Columbia where similar legislation is called for.

The Consolidated Mining and Smelting Company and Ventures—the holding company for the Lindsley interests—have decided on the joint construction of a copper refinery and electrolytic zinc reduction works in Eastern Canada, which will handle the products of the mines controlled by both corporations. This is evidently a counter-blast to the arrangement come to by the Noranda and British Metals for the joint construction of a copper refinery in Eastern Quebec. The location of the two refineries has not so far been announced.

Mexico.—Another of the periodical revolutions is in progress and it is reported that some of the mining towns have been occupied. This need not occasion shareholders undue anxiety, for it will be remembered that towards the end of last year Mr. F. W. Baker, at the Santa Gertrudis meeting, pointed out that during the company's existence of twenty years they had never had to shut down once through any political condition that had existed in the country.

Colombia.—The Viborita Gold Mines, Ltd., has been formed to acquire an alluvial gold-bearing property situate near Amalgi, in the state of Antioquia, which has been examined and tested by Mr. W. E. Thorne, who has spent over twelve months at the mine. The authorized capital is £130,000 in 5s. shares, and the board includes the chairman of the St. John del Rey (who is also chairman of the Viborita) and the chairman of the Frontino and Bolivia companies.

Tin Selection Trust.—Reference was made in the February issue to the increase of the capital of the Tin Selection Trust to £2,000,000 by the creation of a further million shares of £1 each. Of these new shares 500,000 have since been issued to the shareholders in the proportion of one new share for each two held at 25s. per share, thus making the issued capital of the Trust £1,500,000.

Russo-Asiatic.—In view of certain proposals made by foreign groups to acquire part of the reserve share capital in connection with the expansion of the company's activities, the board decided that before coming to any arrangement an opportunity should be given to shareholders to subscribe for part of the reserve shares at a price lower than that contemplated in the negotiations. Shareholders have therefore been offered shares at 3s. 6d. in the proportion of one for each five shares held.

Chemical and Metallurgical Corporation.—In order to provide funds for financing the completion of their Runcorn works on a broader basis than was originally intended, the Chemical and Metallurgical Corporation have raised a further £350,000 by the issue of two million ordinary shares of 2s. each at 3s. 6d. per share, the whole of which have been taken by groups associated with the company, the subscribers having an option till July 1, 1930, on a further million shares at 4s. 6d. per share.

THE ORIGIN OF CUMBERLAND HEMATITE

By the late J. D. KENDALL

This article, which was received a few days before the author's lamented death, consists of comments on reports contained in the Summary of Progress of the Geological Survey of Great Britain during 1927.

In the Summary of Progress of the Geological Survey of Great Britain, 1927, Part 2, there are two papers, with the above title, by Messrs. E. E. L. Dixon and Bernard Smith respectively. Mr. Dixon's portion relates, principally, to the ore occurring in the Skiddaw Slates at Knockmurton and Kelton Fell. Mr. Smith's part is mainly criticism of Mr. Dixon's conclusions. Unfortunately, neither writer has had adequate opportunites of obtaining comprehensive views of the deposits owing to the mines at present opened up being nearly exhausted. Nor are the writers familiar with the nature of the Permian Breccia, which has such an important bearing on the age of the hematite deposits.

On p. 40 of the "Special Report on the Mineral Resources of Great Britain, Vol. VIII, 2nd Edition," Mr. Smith writes:—"In the chief post-Triassic faults examined that we have been able to check carefully, the amount of displacement in the New Red Rocks is as great as in the Carboniferous Limestone, the only exception being E.–W. Baybarrow Fault, and we know of no certain case in which an ore-body has been faulted, except to a very minor degree, since the time of its formation." Mr. Smith does not appear to be very anxious about the facts of observation or he could easily have been convinced that his conclusions, as just stated, are quite wrong. The post-Triassic faults to which he refers are, as I have on a previous occasion stated,[1] not of post-Triassic but of pre-Triassic age. They, or some of them, have had post-Triassic movements. I have already shown [1] that the amount of displacement of the New Red Rocks is much less than that of the Carboniferous Limestone. If Mr. Smith is still unaware of this fact, it can only be that he has not inquired sufficiently. I have before me a section of an important mine in which there is one of these faults that had a pre-Triassic movement of 187 feet and a post-Triassic movement of 590 ft. An ore-body which it intersects is severed by it and part of it carried up to different levels along with other faulted matter. Some of the broken blocks of ore are 300 ft. higher up the fault-plane than others. These figures were established by measurements taken after the mining operations.

[1] Criticism of the Memoir of the Geological Survey, *Mining Magazine*, January, 1920.

On the same page of the Special Report as the above quotation Mr. Smith writes: "Stress is laid upon the occurrence of so-called "pebbles" of hematite in the brockram, as a proof of the previous existence of beds of ore—of pre-Permian age—but in Goodchild's view, these are probably pebbles of limestone converted into hematite after they had been incorporated in the brockram. Our conclusion, therefore, is that in the main the alteration of the limestone into ore was effected in post-Triassic times." In a foot-note to this passage Mr. Smith says, "Possibly as late as Tertiary."

In the "Bearing of the Distribution of Certain Metallic Minerals on their Genesis" [1] and in the "Hematites of West Cumberland and Furness," [2] I have referred to Goodchild's ideas as to the origin of hematite in the Permian Breccia and in the later communication, just mentioned, have given the opinion of Professor P. F. Kendall, of the Geological Department of the Leeds University, in March, 1917, who says: "We are both (Mr. Gilligan and myself) very familiar with the Permian brockram of the Vale of Eden and in the Ingleton area, and in our judgment the hematite in those rocks could not have been derived from destruction of hematite matter. On the other hand, we are equally in agreement that these hematite fragments are true fragments and have not, as Goodchild thought, been produced by substitution, *in situ*, of hematite for limestone." All the pebbles I have seen lack any trace of the fibrous or radial structure of kidney ore. The pebbles of hematite in the brockram of Hoff Beck, near Appleby, present exactly the appearance I should expect if it had resulted from the oxidation of clay ironstone nodules such as can be found in the Coal Measures.

In the second of the two papers just referred to I gave a section of an open-cut working at Bigrigg, which showed the Permian Breccia overlying an ore-body. In referring to the section in its bearing on the age of the ore-bodies generally, I wrote: "So far as I know it has not been seen, in that connection, by anyone but myself, and it is now completely destroyed, so that it may perhaps be useful if a brief

[1] *Mining Magazine*, November, 1920.
[2] *Mining Magazine*, March, 1925.

account of it be given here." The deposit " was worked in such a way that the contact of the breccia and the hematite and the ground for several feet above and below it could be clearly seen. The hematite in the breccia occurred as angular fragments of various sizes. In other places, further away from the ore-body, it was as more or less rounded pebbles, in some cases smooth and occasionally striated. Hematite and limestone fragments were quite common within two or three feet of the main body of ore. They were all angular and some of them as much as eighteen inches in length. Pieces of pure limestone were lying alongside and, in some cases, partly overlying pieces of pure ore." The mine was a very small one and its exhaustion would be soon effected.

On p. 41 of " The Special Report, Vol. VIII, 2nd Edition," Mr. Smith refers to the section just mentioned in the following words: " The section being destroyed it is impossible to check Mr. Kendall's interpretation of the evidence." Why? I invite Mr. Smith to say why. It is impossible to check my drawing, of course, but not to check my interpretation of it. I gave an accurate drawing of the section as I saw it 40 years ago. Most likely it was not in existence a week afterwards, and in a few months the ore-body might be exhausted. It is unfortunate for my reliability as an observer that they did not suspend mining operations. In the last fifty-three years, I have produced several sections in my writings that have not been seen by others, but only this one has been banned. Mr. Smith does not give any part of my written description of the section; he merely locates it and dismisses it as useless, notwithstanding that, by describing it, I considered it important.

It is fifty-three years since I mentioned in the " Hematite Deposits of Whitehaven and Furness " [1] that several hematite pebbles have been found in the breccia representing the Lower Permian." Since then I have repeated the statement several times, in different writings. I should know hematite when I see it. I have mined it, have hammered it thousands of times, have examined it under the microscope many times during the last fifty years and have analysed many samples of it. I have hammered the breccia in every part of the district, have quarried thousands of tons of it, have looked for and found hematite in it frequently, more often near the ore deposits than away from them.

I will now consider Mr. Smith's conclusion that " the main alteration of the limestone into ore was effected in post-Triassic times." His idea is that an iron solution stained the St. Bees Sandstone red, the Permian Breccia red or brown, and produced the purple-grey colour of the Whitehaven Sandstone. It seems to be the Survey-Office idea held by all the members of the Survey I have met.

In a paper on the " Structure of the Cumberland Coal-fields " [1] I divided the Coal measures as under :—

" 1. Whitehaven Sandstone, or Upper Coal Measures.

" 2. Lower Coal Measures, reposing on Millstone Grit.

" The Whitehaven Sandstone is unconformable to the Lower Coal Measures, and on that account it was formerly considered to belong to the Permians, but there is now no doubt about its Carboniferous age."

In the Transactions of the Cumberland and Westmorland Association for the Advancement of Literature and Science, Mr. T. V. Holmes—on the Geological Survey of North Cumberland—in a paper on the " Best Locality for Coal beneath the Permian Rocks of North-West Cumberland," [1] criticizing my paper on the coalfields, just referred to, denied the unconformability of the Whitehaven Sandstone Series, which I had proved, and said " the purple-grey tinting of the beds was due to staining subsequent to their deposition." Further, he correlated seams in what I called the Lower Coal Measures with others in the Whitehaven Sandstone Series. J. G. Goodchild—also on the Survey—was opposed to the unconformability, and agreed with Holmes as to the after-tinting.

When the Geological Survey published their map in 1893 (after 21 years' work) it showed the extent of only a small part of the Whitehaven Sandstone Series in the south-west part of the field, and that was represented as being conformable to the Lower Coal Measures. In the sections accompanying their map they correlated the Four-foot Coal of Cleator Moor with the Moorbanks Band of Workington and the Ten-quarters Coal of Ellenborough and Bullgill. The Five-foot Coal of Cleator Moor they considered to be the equivalent of the Rattler Band of Workington and Bull-

[1] Trans. Manchester Geological Society, 1875.

[1] Trans. Manchester Geological Society, vol. ix, 1883–4.

gill. My work—published 14 years before that of the Geological Survey—led me to the conclusion that the Five-foot Coal and the Bannock Band of Cleator Moor were on the same horizons as the Ten-quarters and the Rattler Band of Ellenborough and Bullgill.[1] In a paper on "The Whitehaven Sandstone Series" I pointed out other serious errors of the Survey in correlation.[2]

The revised map of the Geological Survey, published in 1895, did not show the Whitehaven Sandstone Series. Mr. A. Strahan—one of the revising Surveyors—said there was not any indication of a definite base to the Whitehaven Sandstone Series, and no evidence of its unconformability to the Lower Measures. Sandstone and the productive measures, and the recent work of Mr. C. E. Eastwood bears this out." This was after they had spent twenty-one years in the district—between 1872 and 1893—without seeing it.

I have been obliged to make the above references to the Whitehaven Sandstone Series as its tinting has an important bearing on the source of the solution which replaced the limestone in forming hematite. The members of the Geological Survey do not appear to have looked into this phase of the subject. I give herewith a generalized section (Fig. 1) of the principal rocks forming the coal and iron fields of West Cumberland. The St. Bees Sandstone may be said, generally, to be coloured red. So is the Permian Breccia, but it is mostly much

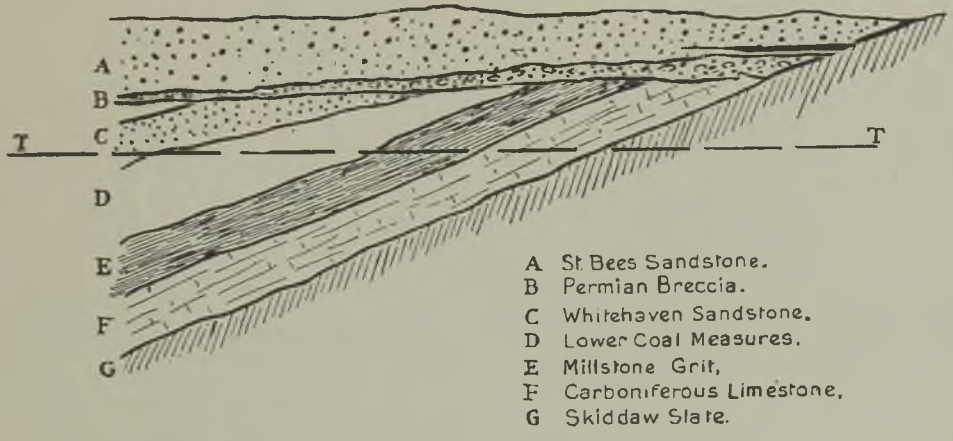


Fig. 1.—General Section of Coal and Iron Fields of West Cumberland.

In "The Summary of Progress of the Geological Survey for 1924" the Survey correlates the Bannock Band and Five-foot Coal of Cleator Moor with the Rattler Band and Ten Quarters of Ellenborough and Bullgill, as I had done in 1883. They further say "In this respect we find ourselves in agreement with Mr. J. D. Kendall." It took the Survey fifty years to find out the mistakes they made in the seventies.

In "The Geology of the Carlisle, Longtown, and Silloth District" issued by the Geological Survey in 1926—dealing with the probable extension of the Coal Measures—the following passage occurs: "In the West Cumberland coalfields evidence has been advanced by Mr. J. D. Kendall [3] for an unconformity between the Whitehaven darker than the overlying sandstone. In fact it is sometimes nearly brown. The Whitehaven Sandstone Series is tinted purple-grey, sometimes slightly red or brown, in the upper parts, but in the lower parts these purple-grey and red beds alternate with strata having the ordinary black, white, grey, and bluish tints of the Lower Coal Measures.

In "The Whitehaven Sandstone Series" [1] I say: "The Whitehaven Sandstone consists almost entirely of Sandstone and Shale, of a red, grey, or brown colour, as described in the sections, but the writer prefers to call it purple-grey. With these beds are intercalated, in the lower part of the Series, rocks of the ordinary coal measure colours and a few thin coal seams. Two thin beds of *Spirorbis* Limestone have been met with in the series at Frizington Hall, and occasionally in different parts of the District."

[1] Trans. Fed. Inst. Mining Engineers, 1895.

[1] Trans. North of England Inst. of M. and M.E., 1883.

[2] Trans. Fed. Inst. Mining Engineers, 1895.

[3] Structure of the Cumberland Coal Field, N. of

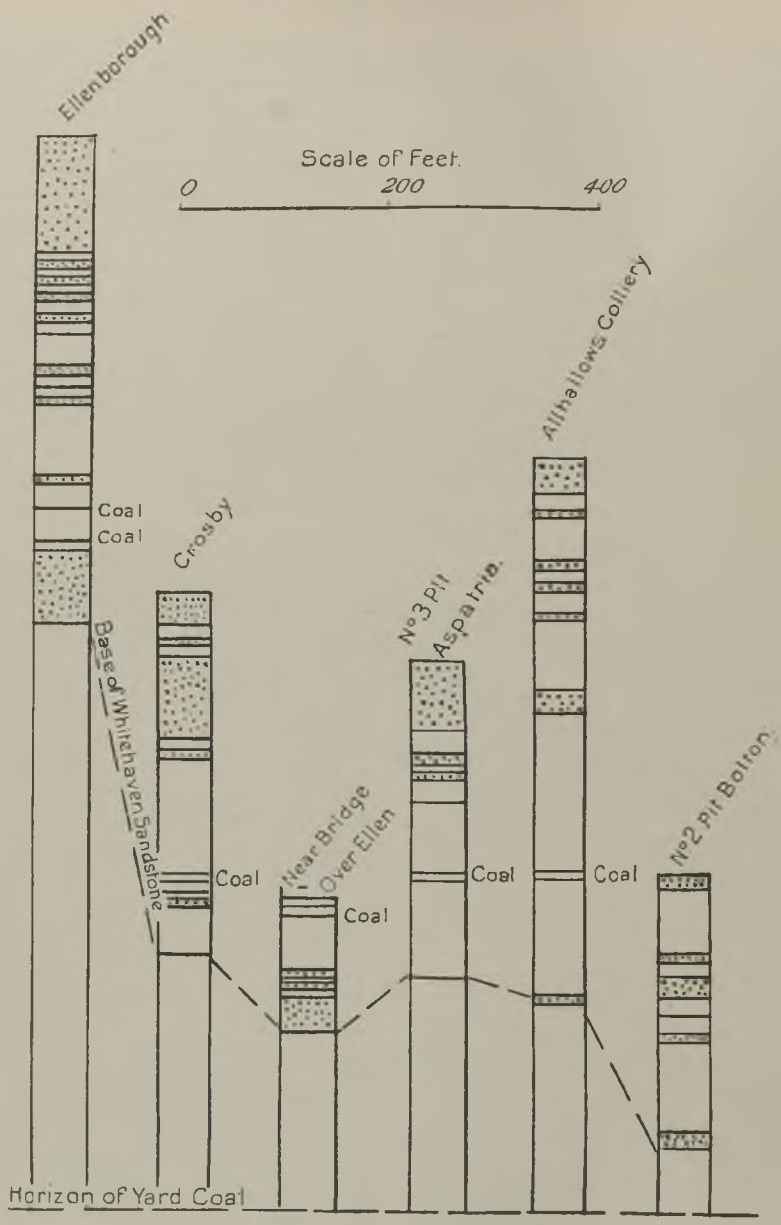


FIG. 2.—WHITEHAVEN SANDSTONE SERIES.

Fig. 2 gives six sections of the Whitehaven Sandstone Series as found between Ellenborough and Bolton. Sixty per cent of the rocks are arenaceous and 40 per cent argillaceous. Forty-three per cent are coloured purple-grey or reddish and fifty-seven per cent have the usual coal measure tints. Of the purple-grey and red beds sixty-seven per cent are arenaceous. As sandy beds occupy sixty per cent of the series it is to be expected that a somewhat similar proportion would have a purple-grey or reddish colour.

Let us look at Fig. 1 and imagine a red iron solution filling the interstices of the St. Bees Sandstone and sinking down through the Breccia, as Mr. Smith suggests, into the Whitehaven Sandstone Series, and at the same time, I say, into the Lower Coal Measures, the Millstone Grit, the Carboniferous Limestone, the Granophyres, and the Skiddaw Slate, as far as the line T–T. If such a staining process had ever taken place there is no reason why the Whitehaven Sandstone Series should not have been stained continuously to the bottom

in the rise portion of it, as shown by the section. Nor is there any reason why the rise end of the Lower Coal Measures, or of the Millstone Grit or the Carboniferous Limestone, or its included shales, should not have been so stained. But they are not, nor is the Skiddaw Slate or the eruptive Granophyre. The purple-grey or red or brown colouring of the beds in the Whitehaven Sandstone Series is shown by dotted spaces in the sections (Fig. 2) and the occurrence between those beds of others which are white or grey, bluish or black, as indicated by the plain spaces in Fig. 2, show clearly that the purple-grey or red or brown beds were so coloured at the time of their deposition and that between those times there were periods, of various lengths, in which there was not any of the purple or reddish colouring matter deposited, and the sand or mud thrown down was white or grey or bluish or black. Some of the white beds, and some of the red ones, are only two feet thick.

After the deposition of the Lower Coal Measures it is evident that there was a large uprise of the terrain, followed first by prolonged denudation, then by subsidence and the deposition of the Whitehaven Sandstone Series. That period of crustal disturbances was probably accompanied by ejections, along lines of faulting of irony matter which might be deposited within the area considered, and carried away later and mixed with the arenaceous and argillaceous debris forming the reddened beds of the Whitehaven Sandstone Series. I say irony matter because iron, in some form or another at that time, seems to have been the subterranean ejectment of the district during crustal movements. The emanations would probably be interrupted by interrupted occurrences, which would increase in intensity for a period, and then gradually cease. During the changes beds of the Whitehaven Sandstone Series might sometimes be reddened, but they might as often have the normal colours of the Coal Measures. The dark red and brown colours of the Breccia and its inclusion of hematite fragments, indicate that it was formed, in some parts, in the neighbourhood of ore-bodies which were partly broken up by the denuding forces that produced the Breccia. The paler red of the St. Bees Sandstone might arise from continuous subterranean ejectments, perhaps supplemented by the denudation of irony material previously deposited.

The above suggestions are, in the nature of the subject, not so conclusive as we could wish them to be on account of the lack of data, but I think they explain the colouring of the red beds much better than the assumption by the Survey of a red liquid permeating the St. Bees Sandstone and sinking into and colouring some of the beds of the Whitehaven Sandstone Series, but leaving other beds, between them, entirely unaltered. The more Fig. 2 is studied the more evident it is that my suggested process of colouring was that which actually occurred. I first suggested it in 1884, in the adjourned discussion of "The Structure of the Cumberland Coalfield." Where the red liquid came from the Survey does not explain, but surely it arose from the deep-down store of all our metallic minerals. If so, why not deal with it in a perfectly natural way?

I will now look briefly at a few statements in Mr. Dixon's paper dealing with other questions. There are a number of hematite veins at Kelton Fell and Knockmurton, crossing the junction of the Loweswater Flags and the Kirkstile Slates. They are more extensive in the latter than in the Flags. The Flags, however, are more fissured and Mr. Dixon thinks these fissures have been the channels through which the mineralizing solutions that formed the ore-bodies passed on their way upward from their previous deeper stage. I do not see any reason for concluding, as Mr. Dixon does, that these joints formed the upward passages of large volumes of material that was deposited as ore-bodies in the overlying rocks, including the Carboniferous Limestone. Nor do they afford evidence that any of the ore in them came from below. In thinking of genetics we must include in our view the great number of ore-bodies found in other parts of the Lake Country, in the Ennerdale Granophyre, the Eskdale Granite, the Volcanic Rocks of Borrowdale, the Coniston Limestone, etc.

Mr. Dixon says: "It has already been suggested by Kendall[1] from the facts of areal distribution that the hematite deposits constitute a zone beyond that of the lead ore." I am not clear what Mr. Dixon means here; the paper he refers to dealt with distribution not with genetics. Mr. Dixon says (p. 26):—"The channels of the iron solutions through the Skiddaw Slate were similar to those of the lead, zinc, and copper solutions, and hematite was deposited not far beyond the limit of deposition of galena."

[1] Lateral Distribution of Metallic Minerals, *Mining Magazine*, vol. xxiii, p. 75.

I think it is unlikely that the hematite, or the iron in it, came from the same subterranean zone as the lead, or they would probably have occurred in veins together. In the various rendings of the uprising anticlinal, some of the fractures would extend deeper than others, so some of them might open up an iron region, while others, perhaps of an earlier or later date, might go into leady accumulations. Further, it is likely that the joints in the underlying slates would probably be fewer and much less distinct than in the flags and therefore there would be much less space in them than in the flags for the rising gases or solutions.

Mr. Dixon says in his conclusions :—" The general body of evidence relating to the Cumberland hematite favours the magmatic theory " which I first put forward in 1883,[1] but, previously, on p. 26 of his communication, he had written in reference to the ore-bodies in the Carboniferous Limestone :—" It has been established beyond question that many have been deposited by downward percolating waters, a fact which, taken in conjunction with the presence of a great thickness of red beds above, and the general tendency of formations, unconformably overlain by such beds, themselves to be reddened from above, seemingly makes it unnecessary to look elsewhere than in the red beds for the source of the iron." I have already, in this communication, and in the MINING MAGAZINE for January, 1920, p. 60, dealt with the later of these two statements of Mr. Dixon.

Referring to the production of the Knockmurton and Kelton Fell veins by replacement, Mr. Dixon writes :—" These replacements appear to have been direct and not to have followed an earlier replacement by dolomite, as suggested by him (Kendall) in one of his later writings." My first reference to replacement through dolomite was in a paper on " The Mineral Veins of the Lake District,"[2] read to the Manchester Geological Society twelve months after I had written about the origin of ore in the Skiddaw Slate at Kelton Fell and Knockmurton, so that in that case I could not have had dolomite in my mind.

On the distribution of ore-bodies in depth Mr. Dixon writes, p. 30 :—" The difference between the north-eastern part of the ore-field and the south-eastern end as regards ore-bodies at the base of the Limestone is discussed by Kendall ; he suggests as the most probable answer that the beds in the north-eastern part have never been bored at the proper place." The main cause of the poverty of the north-eastern part of the district is, as I have always written, the *scarcity of faults* in that area. The extra thickness of drift may have prevented the ground-water reaching the bottom of the limestone, but the more likely reason is that, by the old methodless efforts of searching, the lower beds were never reached at the proper place.

The geological structure of the district had undergone great alterations before the Permian Breccia was formed. Elevations and denudations had occurred to such degrees that the Breccia was deposited on Whitehaven Sandstone rocks, on Millstone Grit, and on Carboniferous Limestone. The occurrence of hematite in the Whitehaven Sandstone Series at Millyeat was therefore just as much within the range of possibility as that found in the Carboniferous Limestone.

The occurrence of associated metals I cannot think has any bearing on the origin of the ore. They were never abundant except at Parkside where the ore was very " loughy ". There they were mainly different forms of lime and silica with some specular iron and a little baryte and pyrite. Fluor-spar I found only in the Bigrigg mines, in very small quantities. When I first found it I mentioned the fact to an analytical chemist practising in Whitehaven, who had probably analysed every ore in the district, and he said I was wrong. He had never had a trace of fluorine in any of his analyses. It was, of course, merely a difference of experience. He had not found fluorine, I had. Messrs. Dixon and Smith have not found hematite in the Breccia, I have.

In a foot-note to Mr. Dixon's paper I find these words :—" Special Report on the Mineral Resources of Great Britain Ed. 2, 1924." This important work will be referred to as the " Memoir." I am glad Mr. Dixon wrote this note as it enables me to complete the general history of my part in producing the revised map. On August 21, 1924, Mr. Smith wrote me asking for information regarding several parts of the West Cumberland Mining District, to which I replied on August 27, 1924 :—" The questions you ask are easily answered, but I want to make it clear to you why I hesitate to help the Geological Survey again." I repeated to him some of my writings to Sir Archibald Geikie after March 30, 1894, which included the following :—" Before the Revising Surveyors left the district, one of them promised, with-

[1] The Hematite Deposits of West Cumberland.
[2] Trans. of the Manchester Geological Society, 1884.

out suggestion of it, to send me a printer's proof of the new map. He did not, however. In consequence, on February 8, 1896, I wrote Sir Archibald Geikie as follows :—" A few days ago I learned that the revised map had been issued in July last. I sent for a copy at once and it has just come to hand. I find that all the errors which I pointed out to you have been rectified in the way suggested by me in my first letter to you, and many others, which I afterwards showed to Mr. Strahan when he was in the district. In fact the map, as far as it relates to the Carboniferous and Permian rocks between Egremont and Mockerkin, is practically my map [for an area of a few square miles] as you will see by reference to my work on the ' Iron ores of Great Britain ' and my paper on the ' Structure of the Cumberland Coalfield.' There are still, however, a few errors which ought not to have occurred, one of which makes the map inconsistent with itself. I notice with great surprise, that it gives the entire credit of the revision to Messrs. Strahan and Goodchild. Surely you are not aware of the nature of the help rendered by me. From the reference to it on p. 72 of your Annual Report of 1894, anyone would, I am sure, conclude that it was simply in the nature of exhibiting to the Survey working plans and boring journals, but I can assure you it was something very different.

" The boundaries of the various formations in the district named were copied by Mr. Strahan from my 25-inch maps on to which they had been laid down by me with the greatest possible accuracy, as the information was accumulated in the course of years, and a very large part of that information was not possessed by any other living being and could not have been obtained by Mr. Strahan if he had remained in the district for years.

" Having said this much perhaps it is unnecessary for me to add that Mr. Strahan did not check the greater part of my boundaries. He did not because he could not, the district being so much covered by drift. He simply copied my lines, and they are almost entirely my lines that are on the altered part of the map. I should be very sorry to think that Mr. Strahan (for whom I have a high appreciation) had put forward these lines as his own, when, as I tell you, he was not even able to check the greater part of them ; I should also be sorry to think that you, being in possession of the facts, should consider it right to give the entire credit of the revision to paid officials of the Survey while I, who gave my labour gratuitously and ungrudgingly, should not receive the slightest public acknowledgement except in your Annual Report which cannot possibly be called a public document in the sense that it obtains any publicity.

" I should much rather it had not been left for me to make such a suggestion, but I think it is only in strict conformity with common usage that the work which is really mine should have been acknowledged on the map. If I had simply pointed out the errors, and left the Survey to correct them, I should not have expected any acknowledgement, but when the Survey adopt such a large amount of my stratigraphical work I do expect some public recognition, and now that the facts have been pointed out to you by me I feel sure that you will not consider that I ask it unfairly."

To this letter, Geikie replied on February 11, 1896 :—" Full and detailed acknowledgement of assistance received are always reserved for the Explanatory Memoir [which Mr. Dixon says has been issued and printer's proof was promised]. When the explanation of the Whitehaven map is issued advantage will be taken of it to state the assistance received from you, and I hope you will find this statement to be satisfactory. I exceedingly regret to find from your letter that no copy of the revised map was sent you. This was an omission for which I beg to offer my sincere apology."

After these quotations from my letters to Geikie, I continued to Mr. Smith :—" Your Memoir does not carry out Geikie's promise, and I think you will agree it should have done. There are many parts in your Memoir which need correcting, in both the Whitehaven and Furness areas, besides those I have already pointed out in my review, and I should in ordinary circumstances have been pleased to help you, but I put it straight to you would anyone, after such treatment as I have received, be anxious to help the Survey, even in a small way. Let the Survey put itself right, then I shall be willing to help in any way I can, and I have much information that the Survey can never otherwise become possessed of."

When I wrote this Sir Archibald Geikie was living, and could have been appealed to. Whatever else happened I do not know, but my correspondence with the Survey ended.

Our geological maps, like the Ordnance maps are sometimes used in our Law Courts without proof of their accuracy. The foregoing may perhaps be useful if it encourages the idea that the maps may or may not be correct, so far as accuracy is possible. Debatable points should always be so treated.

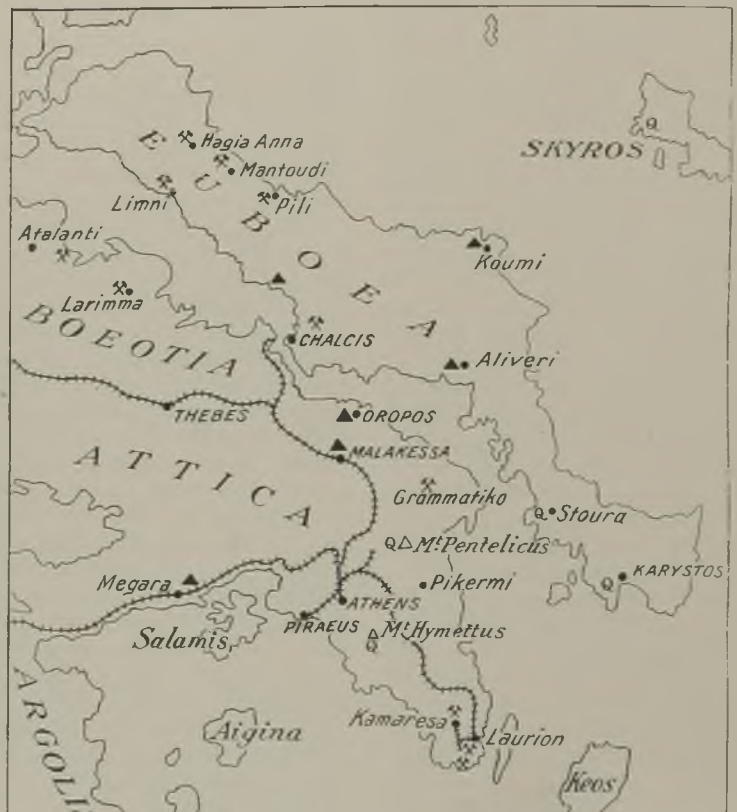
GREECE: ITS GEOLOGY AND MINERAL RESOURCES

By D. A. WRAY, Ph.D., M.Sc., F.G.S., F.R.G.S.

(*Concluded from February issue, page* 90)

MAGNESITE.—Magnesite has for many years constituted one of the more important mineral products exported from Greece. Fifteen years ago upwards of 100,000 tons were obtained annually, though in post-war years the annual production has been considerably less.

The material comes almost wholly from deposited with the magnesite or in separate veins as opal or chalcedony. Magnesite from Styria or Austria, the other main European source of supply, is less pure than Greek magnesite, containing about 8% of iron. Styrian magnesite is also crystalline and is of sedimentary origin, being associated with dolomitic limestones. The following



SKETCH MAP SHOWING PRINCIPAL MINING CENTRES IN THE VICINITY OF ATHENS.

the island of Eubœa, smaller amounts being obtained on the Khalkidike peninsula. Grecian magnesite is fine-grained, amorphous, and massive; and when pure, white in colour. It occurs as lenses or vein deposits in association with intrusive basic magnesian rocks such as gabbros, or more commonly in their alteration product serpentine. Silica which has been formed at the same time is

is an average analysis of Eubœan magnesite: $MgCO_3$, 95·12; $CaCO_3$, 4·02; Fe_2O_3, 0·08; SiO_2, 0·52; H_2O, 0·27%.

The Grecian magnesite is marketed either as "crude" or "calcined" magnesia. The former is essentially magnesium carbonate, while the latter is mainly magnesia or magnesium oxide. The calcination takes place at the mines.

There are again two distinct kinds of calcined magnesia. One known as "caustic" calcined magnesia has only been raised to red heat (or about 800° C.) in long cylindrical rotary calcining furnaces with the result that upwards of 8% of carbonate is still left. In this variety the magnesia is not so inert and is susceptible to reaction with water or carbon dioxide. It also readily combines with certain other reagents such as magnesium chloride, and it is this factor that renders it of great value in the preparation of magnesia cement.

The other variety of calcined magnesia known as "dead burnt" is produced by calcining the raw product at a much higher temperature so that it is partially fused. The resulting product is very dense, fire-resistant, and chemically inert; in this form it is extensively employed in the manufacture of refractories. Magnesia fire-bricks are produced by burning an admixture of caustic and dead-burnt magnesia.

The magnesite deposits of Greece are practically confined to the island of Eubœa, and occur mainly in a belt of serpentine eleven miles long stretching from Limni to Kymassi on the Ægean coast. The average width of the belt is from three to four miles. The serpentine, consisting largely of olivine and enstatite, two minerals rich in magnesia, is intrusive into Cretaceous limestones and is overlain in places by Tertiary conglomerates, marls, and marly limestones. It gives rise to a hilly region, much dissected by deep gullies and consequently well suited for mining by adits.

On the island of Eubœa, there are nine principal workings, four of which are worked by the Anglo-Greek Magnesite Company. Of these one of the more important areas is that leased from the monastery of Galataki and close to Limni on the north-western coast of Eubœa. The chief workings are at Kakabos and Archangelos, where it was formerly obtained along the outcrop. Mining is now being resorted to by means of an inclined shaft. At depths of 120 ft. it shows no signs of exhaustion. The calcining plant, electric power plant, and workshops are on the Gulf of Atalanti, three miles south of Limni. An aerial ropeway three miles long, together with a narrow-gauge railway, connects the workings with the place of transhipment. The annual production is about 20,000 tons and about 300 hands are employed.

A Dutch concession known as the Huyzer Company has smaller mines at Limni and also at Afrati near Chalcis. The former is provided with an aerial ropeway and has also two calcining furnaces. The combined annual production of these two mines is about 15,000 tons.

The oldest and most extensive magnesite workings in Greece are at Mantoudi, eight miles east of Limni in Northern Eubœa. These were commenced some 50 years ago and are now held by a private Greek company. The main deposit is 1,800 ft. long and is over 130 ft. wide in places, and consists largely of a series of thick lenses of magnesite. Up to the present about 1,500,000 tons of magnesite have been extracted, and although mining has been continued to depths of over 350 ft. there is little sign of any decrease in the size of the deposit. The principal workings at Koofala and Geroremma are close to Mantoudi, and about 1½ miles from the small port of Kymassi. A narrow-gauge railway and aerial ropeways connect the several workings. The calcining furnaces are of varying types and the crude mineral is here fired with lignite mined locally. Magnesia fire-bricks are manufactured at Mantoudi on a fairly large scale.

At Daphnopotomous, three miles from Mantoudi, another Greek company is working a very pure deposit of magnesite. The average width of the vein is here from 4 ft. to 5 ft., and it shows no sign of exhaustion at a depth of 60 ft.

Among other localities in which magnesite is being worked are Pili, Gerakini, and Hagia Anna, all in Northern Eubœa. The Anglo-Greek Company has also workings at Afrati, near Chalcis. At Pili, where two companies are operating, the deposits are of an irregular nature, while at Hagia Anna, to the north of Mantoudi, the average width of the principal vein is stated to be 6 ft.

From a detailed study of the occurrences, it is generally agreed that the Eubœan magnesites are replacement deposits due to meteoric waters and it is therefore anticipated that they will be limited to depths of a few hundred feet at the most. No sign of any considerable decrease has, however, been so far recorded.

On the Greek mainland, magnesite was formerly worked on a small scale at Skender Agha, close to the town of Atalanti and in the province of Lokris. On the Khalkidike peninsula, however, there are deposits of greater economic importance and magnesite is at present being mined at Vavdos, twenty

miles south-east of Salonika. The annual output is about 1,000 tons and the magnesium carbonate content is stated to be 95·50%.

Among other localities where magnesite has been recorded but not worked, the most important are Papades, in Northern Eubœa; at Perachori, near Corinth; at Hermione (or Kastri) in Southern Argolis; around Thebes in Bœotia; and on the islands of Spetsai and Paros.

EMERY.—One of the most interesting mineral products of Greece is that of emery, which is extensively exported for use as an abrasive. Practically all the emery comes from Naxos, the largest island in the Cyclades, which has for several centuries furnished practically the whole of that employed in the arts.

It is clear that the material was worked and employed in ancient times, for Aristotle, Theophrastus, and Pliny not only allude to it, but appear to be fully cognizant of its physical properties. On the island of Naxos it occurs as huge loose blocks and boulders in the red soil, and it was only within recent years that it became necessary to mine it from the parent rock. The corundum, of which the emery largely consists, occurs in lenticular masses up to 150 ft. in width and as much as half a mile in length, in a crystalline, often saccharoidal, limestone surrounded by micaceous schists and gneisses. It is considered to have originated from the influence of massive pegmatite dykes which in turn are related to intrusive granite masses. Best Naxos emery is dark grey in colour mottled with bluish streaks. Usually it has a massive or platy structure, and it appears to be an intimate admixture of corundum and magnetite. Other minerals which are associated with it and can readily be detected are tourmaline, muscovite mica, chloritoid, quartz, and sillimanite; and less abundantly, staurolite, biotite mica, rutile, spinel, and iron pyrites. The corundum is usually in small rounded grains or crystals embedded in the iron ore.

Emery also occurs on the islands of Heraklia and Sikinos to the south of Naxos. Its character is very similar, though on the whole it appears to be finer grained and associated with more finely crystalline limestone. It also occurs on the islands of Amorgos, Paros, Nikaria, and Samos, though less abundantly than on Naxos. On the island of Samos it is of a dark blue colour, and occurs in nodular masses.

The workings on Naxos are at Apiranthos and Koronis, the inhabitants of these two communes possessing practically exclusive rights for its extraction. These villages are each about nine miles distant from the coast and the material is transported to small landing stages at Sulinos and Mutsouma respectively. These ports being too exposed to permit of regular navigation, the material is conveyed at Government expense to Syra on a neighbouring island where there is a special depot.

Despite the large amounts that have been removed, the material is still extracted in a rather crude fashion. Smaller blocks are transported as obtained, while larger masses are broken either by heavy sledge hammers or by the application of heat and subsequent sudden cooling with water. The industry finds regular employment for about 1,000 hands. The material is shipped in lumps varying from the size of a pea to 25 lb. in weight. In former times it was exported as ballast, but it is now shipped as a regular cargo.

Prior to the European War about 10,000 tons were extracted annually, though within recent years the annual production has been more than doubled. By far the largest amount is exported to the United States, smaller quantities going to France, Holland, and Germany. The mining of emery is a State monopoly and it constitutes one of the sources of revenue for the International Finance Commission established in 1898 for the payment of the public debt of Greece. The success of mining is, therefore, of some importance to a number of British and French bond-holders. The State exercises little effective control over the actual mining operations, its supervision being chiefly extended to the quality of the material gathered for export. Prior to the War needless waste ensued, much excellent and high-grade material being abandoned or covered with debris. This, however, was much improved by the French technical supervision exercised in 1918. The development of the metallurgical industry in America has given considerable impetus to the industry, though its most serious competitors are the increasing amounts obtained from Smyrna, an emery softer in character and more suitable for polishing, and the employment of artificial abrasives. According to the eminent French mineralogist De Launay, some 5,000,000 tons of reserves are still available by the simple process of quarrying and blasting.*

Oil Resources.—The most promising areas for the production of oil in Greece are undoubtedly those within the western folded zone. Indications have been recorded from other districts, but they are not likely to prove of any great practical importance. The two districts in which investigations have been carried out are, respectively, on the island of Zante, and in Epirus in the vicinity of Dragopsa, twelve miles west of Yanina.

The occurrence of bitumen on the island of Zante was well known to the ancients, and the historian Herodotus, who visited the island in the fifth century before the Christian era, states that "he had seen pitch drawn up out of a lake and from water in Zacynthus (Zante); and there are several lakes there; the largest of them is 70 ft. every way, and two orgyæ in depth; into this they let down a pole with a myrtle branch fastened to the end, and then draw

The Parthenon on the Acropolis built of Marble or Massive Limestone from the Quarries of Mount Pentelicus.

up pitch adhering to the myrtle; it has the smell of asphalt. They pour it into a cistern dug near the lake, and when they have collected a sufficient quantity, they pour it off from the cistern into jars." (Melpomene iv, 195). These shallow wells have been productive throughout the historic period, and at the present day they still yield considerable quantities of pitch. The material comes from the Upper Miocene and Pliocene limestones in the low-lying and marshy district of Chieri, and within the last fifty years various borings have been made both by the Greek Government and an English Syndicate to investigate its potentialities as a source of oil. Wells sunk within recent years to depths of about 300 ft. are stated to have yielded both gas and oil in varying amount, and storage tanks are in course of erection.

At Lintzi, or Loutra Kyllenes, on the west coast of the Peloponnesus directly opposite the island of Zante, exudations of petroliferous oil are recorded from Pliocene limestones. Lintzi is a popular summer resort, and connected by rail with Patras and Corinth. Within the same area, bituminous limestones of Cretaceous and Eocene age occur on the island of Cephalonia and on the mainland of Greece in Western Acarnania. Asphaltic limestones of Eocene age also occur on the islands of Paxos and Antipaxos

Street Scene in Comotini, Western Thrace.

to the south of Corfu. They are stated to have an average content of 14% of asphalt.

Of a similar nature are the asphaltic Nummulitic limestones of Marathos or Marathopoulis. These contain bands uniformly impregnated with asphalt, the mean yield ranging from 7 to 8%. Marathos is a small port along the south-western coast of the Peloponnesus.

For the past few years preliminary investigations have been conducted in what appears to be a promising oil area in Northern Epirus.

Twelve miles to the west of Yanina, and

at an altitude of about 6,000 ft., is a long narrow defile trending north-north-westerly for a total length of some forty miles. The southern portion of it is drained by the river Vyros, while in the northern half rises the Malitsa, which flows northerly to join the River Kalamas. For the greater part of its course, this rectilinear defile follows the course of a prominent line of overthrust, and in the vicinity of Dragopsa, the Flysch shales and sandstones of Lower Tertiary age come to rest on Miocene sandstones. In the latter beds, numerous exudations of heavy and dark-coloured bituminous oil have been observed, while small lenticular masses and pockets of solid bitumen also occur in the sandstone, particularly along or close to the line of overthrust. Several trial borings have been made to depths ranging up to 220 ft. and from some of these small quantities of oil have been obtained. In some cases the upper layers are associated with saline water, while small quantities of gas were also observed. Some of the lower beds of sandstone also contain abundant impregnations of bitumen.

At Phanari, near Trikkala, on the eastern slopes of the Pindus range and bordering the plain of Thessaly, shales with lenticular masses of bitumen occur interbedded between sandstones and conglomerates assigned to the Burdigalian or Lower Miocene formation.

There are numerous other scattered areas in which the occurrence of bituminous materials have been recorded but whether of any economic importance is doubtful. Thus at Vordo, in the Artinos or Arackthos valley in Etolia, thin lenticular layers of bitumen have been observed in Flysch sandstones associated with rock salt. Similar occurrences have also been recorded from Dremissa, near the headwaters of the river Cephissus in Central Greece, fifteen miles south of Lamia, and from the neighbourhood of Galaxidi, on the bay of Salona, and along the northern shores of the Gulf of Corinth.

In the Peloponnesus, thin bituminous shales occur associated with massive hornstones of Triassic or Jurassic age at Divre, Souli, Proussos, and Granitsa in the neighbourhood of Mount Olonos; while asphaltic limestones, probably of Eocene age, are recorded from the vicinity of Vamvokou, twenty miles north of Sparta in Laconia.

Marble.—The relative abundance of so much pure marble in Greece contributed in no small degree to the general excellence of ancient Greek sculpture and architecture. The extensive quarries of Mount Pentelicus to the north of Athens furnished a material of high purity and suitable texture, and it was extensively employed in the erection of the Parthenon and other noble buildings in ancient Athens. These, along with other famous Greek quarries, lay neglected for many centuries and were first reopened by a Bavarian sculptor, Seigel, some seventy years ago. Pentelicon marble is a singularly pure and beautiful stone admirably adapted for statuary and public buildings. Though principally white the quarries also yield a dark blue marble termed "Melana" or ink marble. The quarries at Mount Pentelicus are now owned by an English company who have an extensive plant, and a branch railroad has been constructed to facilitate transport. Modern Athens and the Piræus are largely built of Pentelicon marble.

In the same district are the ancient quarries of Mount Hymettus, which yield a greyish-blue marble veined with darker streaks, not so highly prized by the ancient Greeks. It appealed strongly, however, to the Roman fondness for colour and was somewhat extensively worked by them.

The famous "Parian White" marble from the island of Paros is finer grained than Pentelicon marble and is spotlessly white. The finest variety known as "Lychnites" was so named by the ancients because it was quarried underground by the light of a miner's lamp. Parian marble is largely worked out. Some years ago it was obtained from underground workings in the vicinity of Paroikea, but these quarries are now idle.

Several firms, including an English company, have also worked coloured marbles and serpentines on the island of Tenos, mainly for interior decoration. The quarries on the island of Skyros are more important, and considerable quantities have been exported from time to time. These workings are equipped with modern machinery, and good facilities for transhipment have been provided. The several varieties of Skyros marble include snow white from Colonnæs, red or yellow from Trisboukæs, and "Skyros breccia," or variegated marbles, from Valaxa, an islet off the south-west coast of Skyros.

In Southern Eubœa there are large and ancient marble quarries around Karystos and Stoura. The former yield "cipillino," a greyish marble with green veinings much prized by the Romans. The quarries near Stoura have been reopened in recent years

and the marble, extracted in great lengths, has been much used for ornamental work.

In 1894 the original source of the famous green marble known as "Verde Antico" was rediscovered by Brindley, an English contractor, at Kassamboli in Thessaly between Larissa and the Vale of Tempe. Here the ancients obtained large monoliths employed so effectively for decorative purposes in Rome and Constantinople. Many fine columns have been extracted and exported to America and Western Europe.

Among other localities where marble has been quarried within recent years are the islands of Chios, Lesbos, and Naxos, and on the Peloponnesus in the Maina peninsula, and in the vicinity of Argos on the Gulf of Nauplia.

Other Building Materials.—Fine-grained granite from the islands of Tenos, Seriphos, and Naxos have been quarried for decorative purposes, while trachytic rocks, which are very widespread on the Cyclades archipelago, have been extensively employed for building and paving stones. A whitish trachytic tuff on the island of Kimolos is also in considerable demand in Greece for doorposts and window lintels. In the Athens and Piræus districts there are now two large cement factories employing local argillaceous limestone, with an annual output of over 60,000 tons. Volo has also become a cement-manufacturing centre for Thessaly and Northern Greece, and Greek cement is now well known in the interior of the country.

The manufacture of bricks and tiles has also increased considerably within recent years. White clays for the manufacture of common pottery are worked in the vicinity of Athens, Thebes, Megara, Patras, and on the island of Siphnos. The potter's clay from which the ancient Athenians moulded their delicate yet comparatively strong vases came largely from the vicinity of Cape Kolias on the Bay of Phaleron. Modern Athenian potters obtain their material principally from Ampelokipi and Kalogreza.

Kaolin and china-clay come mainly from the islands of Melos and Kimolos, where they have been formed by the alteration of trachytes. Deposits of kaolin also occur on the islands of Antiparos and Mykonos.

At Reuma, on the island of Melos, a quartzose trachyte has been exploited for many years for the production of millstones. About 50 tons are obtained annually.

Puzzolana and Pumice.—Puzzolana consists of volcanic ash, which, when mixed with lime, forms an admirable cement for hydraulic purposes and has been in much demand for extensive harbour works. It occurs in considerable quantities on the volcanic islands of Santorin (or Thera) and Therasia, and also on the neighbouring small islet of Aspronisi. The mining and preparation of puzzolana is in normal years an important industry on Santorin, and the annual production in recent years has averaged 60,000 tons. About 1,000 tons of pumice stone is also exported annually.

Other Minerals.—One of the most important of these is native sulphur, of which about 2,000 tons is obtained annually. Practically the whole of this comes from the volcanic island of Melos. Since 1861 two private companies have been working native sulphur which occurs in large masses in a porous trachyte in the vicinity of Mount Kalamo. The average content of sulphur in the material from Melos ranges from 30 to 50%. Native sulphur also occurs at several places in Attica, on the Peloponnesus, and in several islands in the Ægean archipelago.

Within recent years, talc has been mined on a small scale in talcose schists at Chortiati, near Salonika, and about 150 tons were obtained in the past year. Talc is also worked at Panormos on the island of Tenos and shipped to Syra.

Bauxite is fairly widespread in the limestone regions of Western Greece, and within recent years somewhat extended investigations have been made to ascertain its probable value.

The little treeless island of Kimolos has from ancient times onwards yielded small quantities of fuller's earth, locally known as Kimolian earth, but the industry is comparatively unimportant.

In a similar manner alum has been worked on a very small scale at Zephyria on Melos for centuries, and as early as the first century of our era we are informed by Pliny that "the alum of Melos was reckoned next to that of Egypt."

Gypsum is worked by several small companies in Etolia, and also on the islands of Melos, Crete, Zante, Cephalonia, and Skyros.

The Greek State does not possess any salt deposits of economic importance, and the country's requirements are met in part by evaporation in salt pans and also by importation from abroad.

THE GEOLOGY OF ROSKEAR SECTION DOLCOATH MINE

By E. H. DAVISON, B.Sc., F.G.S.,
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In THE MINING MAGAZINE for June, 1926, the author described the geology of the Roskear shaft which at that time had been sunk to a depth of 1,000 ft. Since that date the shaft has been extended to a depth of over 2,000 ft., and levels have been driven north and south from the shaft at depths of 1,700 ft., 1,900 ft., and 2,000 ft. respectively. Lodes have been cut, ore has been developed, and tin concentrate sold, so that the shaft has developed into a working mine which is unfortunately at a standstill at present owing to lack of working capital.

HEADGEAR AT DOLCOATH NEW SHAFT, ROSKEAR, CAMBORNE.

The geological interest of this mine lies in the fact that it gives an excellent section of the rocks overlying the granite. These rocks, over 2,000 ft. in thickness, are cut by the shaft and levels so that the contact metamorphism can be studied in detail.

The Roskear shaft lies nearly a mile to the north of the granite outcrop of the Carn Brea ridge and about a quarter of a mile to the west of the great fault which runs north and south up the Tuckingmill valley. The rocks cut by the shaft and levels include the following :—

Clay-Slate of Palæozoic (Devonian ?) age ;
Epidiorite (Greenstone) sills penetrating the Clay-Slate and affected by the same folding ;
Granite which alters the Clay-Slate and Epidiorite ;
Veins of Pegmatite and Aplite ;
Dykes of Quartz-Felspar-Porphyry which cut the Clay-Slate, Epidiorite, and Granite.

These rocks, with the exception of the pegmatites, aplites, and porphyries, have been altered by the contact metamorphism resulting from the granite intrusion, the types of alteration produced varying with the rock and the distance from the granite surface. The chief alterations of the clay-slate, epidiorite or greenstone, and granite are described in the following paragraphs.

The clay-state, when seen fresh, outside the metamorphic aureole of the granite, is a blue-grey rock with irregular jointing and coarse cleavage. It dips away from the granite in a series of irregular isoclinal folds, that is, to the north in the Roskear area.

At the top of the Roskear shaft (about 300 ft. below surface) the clay-slate is of

a dark blue-grey colour with well-developed spotting, the dark spots consisting of dark mica and iron ore. Cleavage is well defined and follows the dip to the north. Further down the shaft the slate hardens, cleavage becomes less distinct, and chiastolite and andalusite are developed, while lenticular films of pyrites and pyrrhotite occur, the latter possibly resulting from contact with the neighbouring epidiorite.

At still greater depths the slate becomes highly micaceous, cleavage entirely disappears, and tourmaline often occurs in considerable amount. Some specimens taken at a depth of 1,600 ft. or more show under the microscope the characters of a mica-schist with complexly folded folia.

When close to the granite the slate takes the form of either a dense flinty hornfels or a completely tourmalinized slate in which all the argillaceous constituents of the rock have been converted into tourmaline.

There was no sign at any point of absorption of the slate by the granite or of magmatic stoping.

In the mine levels (1,700 ft. to 2,000 ft.) the slate is seen to be a dark, almost black, rock with no cleavage but with irregular jointing, and its compactness is shown by the fact that with the exception of small seepages from vein fissures the levels are absolutely dry.

The epidiorite, or greenstone, is cut by the shaft from surface to 300 ft. and from 750 ft. to 950 ft. It was an exceptionally hard rock and made drilling operations slow and expensive. Its impervious character, however, effectually cut off surface water and the water in the old mine workings nearby, so that the shaft was sunk and levels driven without encountering any trouble from water.

The chief type of alteration in the greenstone is that in which the rock shows lenticles of red almandine garnet which run through the rock forming one-third of its bulk. Associated with the garnet we find epidote, zoisite, pyrrhotite, and axinite, the last mineral sometimes occurring to the exclusion of the garnet. Tremolite occurs in veins and lenticles and sometimes large lenticles of pyrrhotite occur.

A type of altered epidiorite that occurs with the garnetiferous rock is veined with pale green lenticles composed of epidote and albite.

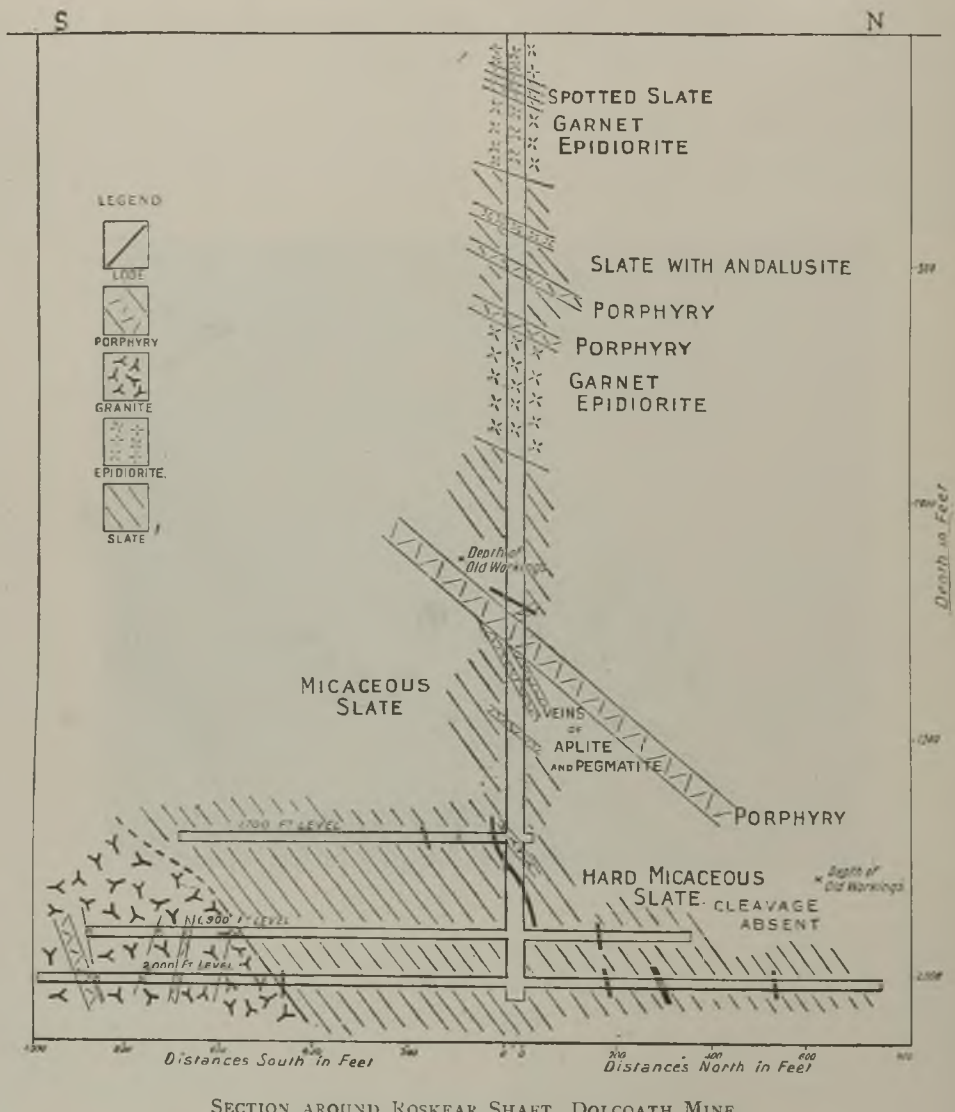
The epidiorite is not seen close to the granite; consequently we do not see any examples of intensely altered epidiorite such as the bleached and spotted rock which occurs near Penzance.

Bottom of New Roskear Shaft.

One narrow band of altered epidiorite was cut which contained much pink garnet in idiomorphic crystals with dark mica, but this type was only seen once, the band being only a few inches wide.

the slate was sharply defined and there was no sign of chilling in the granite vein.

The main granite mass also showed a clear-cut contact with the slate. In texture it is coarsely crystalline with ill-shaped



SECTION AROUND ROSKEAR SHAFT, DOLCOATH MINE.

The granite mass was not cut in the shaft but veins of granite penetrating the slate were cut through and the main mass was cut in the 1,900 ft. and 2,000 ft. levels. The veins cut in the shaft were of both fine and coarse-grained granite, the former usually containing tourmaline and occasionally molybdenite. The contact of the vein with

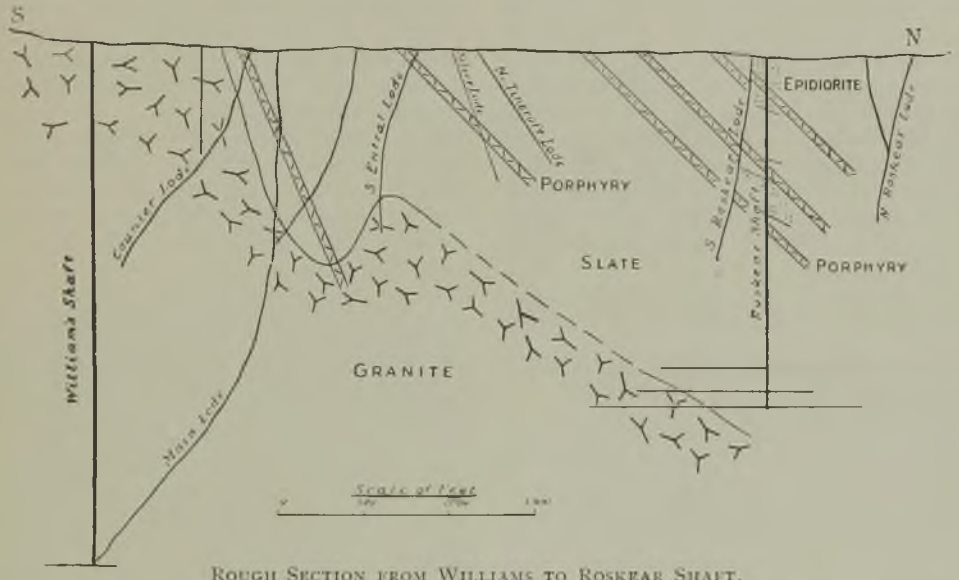
felspar crystals and a little biotite, while white micas including muscovite and gilbertite were common. Tourmaline was of common occurrence but when it occurred no biotite was present. Samples of granite closely resembling the luxulyanite type occurred in veins, being composed of pink orthoclase, tourmaline, and quartz. The rock is

irregularly jointed and shows pink felspar in the neighbourhood of the lodes.

Some of the granite veins showed minute veinlets of granite material penetrating the slate on either side.

In sinking the shaft many veins of pegmatite and aplite were cut in the slate. The pegmatite veins were seen to shade off into aplite and these into quartz veins, the following being some of the chief types observed :—

Pegmatite composed of very coarsely crystallized quartz, idiomorphic perthite, lepidolite mica, pink garnet, and occasional molybdenite. Also pegmatite composed of coarsely crystallized quartz, orthoclase, and tourmaline.



Rough Section from Williams to Roskear Shaft.

Aplite of medium grain composed of quartz, orthoclase, and soda-lime felspar with lepidolite. Also aplite with a very small proportion of felspar and some pink garnet, Quartz veins with a little scattered white mica.

As regards the quartz-felspar porphyry dykes, several of these dykes were cut both in the shaft and in the levels. At a depth of 500 ft. in the shaft a dyke was cut which was 30 ft. wide and dipped to the north at about 45°. It was composed of quartz and felspar phenocrysts in a micro-crystalline ground-mass of quartz, felspar, and sericitic mica.

At the 1,300 ft. level a dyke about 50 ft. wide was cut which was composed of phenocrysts of quartz, felspar, and radiating patches of tourmaline needles in a ground-mass similar to that of the dyke above, but showing the translucent character which is found in the porphyry dykes cut well below the zone affected by meteoric water.

In the 1,900 ft. level a dyke similar to the above was cut and several other small dykes were cut in the two lower levels.

After sinking the shaft, levels were driven at the 1,700 ft., 1,900 ft., and 2,000 ft. levels, the first extending some 700 ft. south, the 1,900 ft. level over 900 ft. to the south and 340 ft. to the north, and the 2,000 ft. level 1,000 ft. to the south and over 700 ft. to the north. Thus a considerable block of ground was opened up and a number of lodes cut.

The 1,900 ft. level cut the granite main mass about 500 ft. to the south of the shaft, while in the 2,000 ft. level the granite was cut at about 400 ft. to the south of the shaft. Thus the granite surface slopes to the north at about 45°. It is significant that a number of the granite veins cut by the shaft dip to the north, which suggests that the granite surface may rise to the north or, at any rate, slope at a very gentle angle.

A number of lodes have been cut by the workings already driven and they carry such minerals as chalcopyrite, wolfram, mispickel, and cassiterite, which indicates that the levels of the mine are situated in the upper part of the tin zone, and suggests that the tin ore will probably extend to a

considerable depth below the level. Of the lodes cut two are worthy of detailed description.

A complex lode 270 ft. north of the shaft in the 2,000 ft. level consists of a breccia of quartz and slate cemented by quartz and chlorite. The metallic minerals include mispickel, chalcopyrite, wolfram, cassiterite, and stannite with a little hematite. The wolfram was often seen to be altered to pink scheelite along the margins, which reminds one of the Rogers lode at the 190 fathom level. In fact the whole character of the lode is very similar to that of the Rogers lode which, as the situation of both lodes relative to the granite was very similar, is just what one would expect.

An interesting feature in this lode is the occurrence of a lenticular vein of pegmatite in the lode itself running along the strike of the lode near the hanging wall. The pegmatite is composed of very coarsely crystallized quartz and pink orthoclase with cassiterite, mispickel, and chalcopyrite.

The south lode was cut in both the 1,900 ft. level and the 2,000 ft. level, and at about 700 ft. to the south of the shaft, the lode being nearly vertical. It is thus in the granite mass and is composed of quartz, chlorite, and cassiterite, all these constituents being coarsely crystallized. It is a veinstone that would be easy to concentrate in the mill as the cassiterite is coarse and the veinstone minerals would be easily separated when crushed. Under the microscope this veinstone is seen to contain narrow veinlets of cassiterite, of later date than the coarsely crystallized tinstone, which cut through all the coarsely crystallized minerals.

While the lodes already cut are in several cases valuable ore-bodies the fact that the lower levels have only reached the upper part of the tin zone indicates that deeper development is necessary and at the same time the fact that well defined tin-bearing lodes occur at the present levels makes it probable that the lode values will persist to some depth below.

The author has to acknowledge the kind way in which both Mr. R. Arthur Thomas and Mr. J. C. Vivian have given him every assistance and facility in gathering material for this article.

LETTER TO THE EDITOR

Cubic Magnetite and Hematite

The Editor :

SIR,—I read with interest Mr. J. B. Scrivenor's letter on "Cubic Magnetite and Hematite" which was published in your January issue. Since there seems little doubt that the cubes referred to are pseudomorphs of magnetic hematite after pyrite, it has occurred to me that the change may have taken place in two stages, thus :—

$$\text{Pyrite} \rightarrow \left\{\begin{array}{l}\text{Hematite or}\\ \text{Hydrated Oxide e.g.}\\ \text{Limonite, Gothite, etc.}\end{array}\right\} \rightarrow \text{Magnetite}$$

As regards the conversion of pyrite into hematite or limonite, this is common enough in the zone of weathering and many examples of such pseudomorphs have been recorded from all parts of the world; the second change, however, namely, that of the conversion of hematite into magnetite, seems to demand thermal action of some kind. Pure dry ferric oxide on heating in air to about 1,000° C. undergoes conversion into ferroso-ferric oxide (magnetite), a change that may be represented by the following equation :—

$$6Fe_2O_3 \text{ (at } 1{,}000°C) \rightarrow 4(Fe_2O_3.FeO) + O_2$$

This reaction is retarded by large amounts of alumina or other oxides, but the presence of reducing agents lowers the conversion temperature very considerably. Thus, Moissan found that, in presence of hydrogen, the change could be effected at 350°–400° C., and it seems highly probable that other reducing agents such as sulphur, carbonaceous matter, and possibly superheated steam would also act in a similar manner. Whether the conversion into magnetite was complete or only partial would depend upon the quantity (and potency) of reducing agents present and also upon the temperature and its duration.

In connection with this matter I note that C. R. Van Hise in his "Treatise on Metamorphism" (Mon. U.S. Geol. Survey, Vol. 47, 1904, p. 229) states that magnetite can form from marcasite, pyrite, and from the oxidation of siderite in place.

I think it highly probable, therefore, that the cubes Mr. Scrivenor mentions were originally pseudomorphs of hematite (or limonite, etc.) after pyrite which have suffered partial conversion into magnetite by thermal matamorphism.

C. STANSFIELD HITCHEN.
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February 9.

BOOK REVIEWS

The Nomenclature of Petrology. By ARTHUR HOLMES, D.Sc., A.R.C.Sc., D.I.C., F.G.S., Professor of Geology, the University, Durham. Second edition. Cloth, octavo, 284 pages. Price 7*s.* 6*d.* London: Thomas Murby & Co.

Nine years ago, when the first edition of Professor Holmes' "Nomenclature of Petrology" was published, the author made available to puzzled students, and to geologists greatly perplexed by scores of long cacophonous petrological terms, a volume which has now become firmly established as a standard work of reference occupying a prominent place on their bookshelves. The only previous independent publication of this kind was the *Lexique Pétrographique* of Lœwinson-Lessing, published in Paris in 1901, and the introduction of numerous new terms in the two decades following that publication, had rendered it a very inadequate guide through what Holmes aptly terms "the somewhat tangled forest of names."

Except for bizarre terms, odd prefixes, and cumbersome combinations that fortunately have been jettisoned by leading petrologists, the original volume contained practically every technical term used by modern petrologists in reference to igneous, sedimentary, and metamorphic rocks; their textures and structures; and terms used in relation to igneous bodies and rock occurrences. These terms, arranged alphabetically, are defined briefly but sufficiently comprehensively to express clearly their meaning. In the majority of cases the name of the introducer of the term, and useful references to literature dealing with the rock defined, are added.

Besides being a standard work of reference, the volume has played an important part during the last few years in limiting the elasticity of petrological terms, and in discouraging the use of such outlandish words as "hydrosilicirudyte," "rhomfelspvralisyenite," and "eudœgi-midalkalite." On the other hand, the author has wisely advocated the use of descriptive names like "biotite-hornblende-granite," "granodiorite," and "trachyandesite" which are self-explanatory. In this connection Professor Bonney's words are very relevant: "Time is not so valuable, or paper and printing so expensive, that we should talk or write 'gibberish' to save a few letters."

Very useful appendices are given containing translations of French and German petrographic terms, and the meaning of Greek and Latin words that have been used as prefixes and roots in compounding petrological names.

The call for a new edition has provided the author with the opportunity for making a few corrections and two or three slight modifications. A number of new terms have been introduced during the last eight years into petrological literature, but for the most part these are of minor importance and have not been incorporated in the second edition. The author decided that the needs of students would best be served at this stage by a re-issue of the original, suitably revised, particularly as the adoption of this course made possible a reduction in price.

The reviewer has seen this standard dictionary of petrological terms on the bookshelves of geologists in five different countries, and he is strongly of opinion that for a book that is so widely distributed on the continent, and in America, the publishers have been extremely unfortunate in their choice of paper and type.

WILLIAM R. JONES.

Field and Colliery Surveying: A Text-Book for Students of Mining and Civil Engineering Surveying. By T. A. O'DONAHUE and T. G. BOCKING. Second Editon. Cloth, octavo, 340 pages, illustrated. Price 10s. 6d. London: Macmillan and Co., Ltd.

Consisting of 24 chapters and some appendices and including 232 excellent figures, this work deals, among other matters, with the surveyor's office, geometry, mensuration, trigonometry, surface surveying, dialling, theodolitic traversing, levelling, calculation of areas and volumes, ordnance maps, geological maps, setting-out, mathematical tables, the Coal Mines Act, and examinations for surveyor's certificates.

The aim of the book is plainly stated in the preface. The scope is displayed by the sequel. Written by men well acquainted with colliery surveying, this attractive and handy volume will be particularly useful to those desirous of obtaining qualifying certificates, even though their previous mathematical training may have been somewhat meagre.

The authors disclose a sympathetic desire not only to instruct the student but also to interest him. While using a style simple, clear, and convincing, they intersperse the text with an abundance of admirable figures and a number of arresting historical statements. Frequently their treatment is concisely sufficient and at times almost generous. And they are to be congratulated on the improvement effected in this latest edition.

Yet at the same time it must be regretted that the authors at the end of their preface say they believe that the revised book covers the chief requirements of students and teachers of mining and civil engineering surveying. How can it? Many of the fundamentals of whole branches of such surveying are not even mentioned. The chapter on the theodolite occupies only 12 pages, that on theodolitic traversing 17 pages, and the section on theodolitic triangulation about 2 pages; while correlation is disposed of in 4 pages and plane-tabling in 2. And how can the subtitle hold? Visualized must be the steeply inclined shafts, winzes, and stopes of many of our great mines, the intricate excavations recently completed at Piccadilly Circus and the vast oil-fields and mining areas abroad. The substitution of the words "a few of the" for "the chief" near the end of the preface and the deletion of the subtitle would have put the authors square in this regard. It would, too, have been better just in a small way if the misleading "slightly" on p. 71 had been omitted and the maximum of 540° stated or hinted at; if the dubious statement on p. 139 about the placing of the "upper level" had been absent; if some more appropriate terms than "spider's hairs" on p. 138 and "parallel glass" on p. 142 had been chosen; and if generally inconsistency in the naming of instrument parts had been avoided by following the best British practice.

In spite of these criticisms mainly directed, be it noted, not at the body of the book but at its appendages, it must in all fairness be stated that the book is a sound work worthy of praise; worthy also of a place in any library of mine-surveying books; and worthy of appreciation by those for whom it was primarily intended, the prospective colliery surveyors in Great Britain.

F. W. ARMSTRONG.

In reviewing **The Geology of Petroleum and Natural Gas** in last month's issue, I referred to the fact that the cover and title page gave the name of English publishers, whereas the book was an American production. I would like to make it perfectly clear that I had no intention of giving offence to the firm in question, nor, in view of the name of the American publishers being given on the reverse of the title page—to which I referred—was there any question in my mind as to a desire on the part of the English firm to mislead prospective buyers. I am assured that the usual practice was followed in this case, and it is stated that it enables buyers here and on the Continent to secure books more promptly than would otherwise be possible. At the same time I feel it would be better if in cases of this character the names of the American publishers were given on the cover and title page as well as those of the London selling agents.—MURRAY STUART.

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

NEWS LETTERS

JOHANNESBURG

January 7, 1929.

RECORD GOLD OUTPUT.—It appears that 30,598,754 tons of ore were milled in 1928 to produce the Transvaal's record gold output of 10,358,596 ounces, valued at £43,537,290. Compared with the corresponding figures for 1927, there is an increase of 969,497 tons in the ore milled, and the total yield is 227,966 ounces greater. But the year's profit of £13,030,200 shows a decrease of £110,000. The revenue per ton milled is 3d. down, and as the working costs per ton are a penny higher, the profit per ton for the year shows a decrease of 4d. At £8,458,693 the total of the dividends declared is £35,320 higher than in 1927.

EAST GEDULD MINES.—According to the latest official information, highly satisfactory values continue to be disclosed by the East Geduld Mines in its lease area, and the opinion is expressed in Rand mining circles that this company will probably become as good a dividend payer as its prosperous western neighbour, the Geduld Proprietary Mines. At present development of the East

Geduld Mines area is being done from the eastern workings of the Geduld Proprietary Mines, but it is generally believed that shaft sinking will shortly be started.

Postmasburg Manganese Field.—A group of British iron and steel masters has made arrangements with the Union Manganese Mines and Minerals, Ltd., whereby the large deposits of manganese ore in the Postmasburg districts will be developed provided the Union Government comes to a businesslike arrangement for the construction of a railway from the fields to the main line. The original intention was to send the ore to East London for shipment, but it has since been ascertained that Durban is the better and cheaper port, although the distance over which the ore will have to be carried is nearly 40 miles greater. It is stated that the cost of transporting the ore from Postmasburg to Durban will not exceed 12s. 6d. per ton and that a profit of 15s. per ton of ore is anticipated.

Nitrates in South-West Africa.—It was reported recently that extensive nitrate deposits had been discovered in the Marienthal region, South-West Africa. The facts, as obtained from official sources, are that 30 base mineral prospecting claims, aggregating 2,500 acres, were pegged out by the discoverer and his associates who then applied for a concession over an area in the vicinity. The application was refused. With the object of preventing a rush of promiscuous pegging and of enabling the Administration to deal with these deposits in the most advantageous manner, it was decided that if, on further examination, the deposits were found to be of value, the whole area in which there appeared to be any likelihood of the finding of nitrates would be closed to pegging and prospecting for this and allied minerals until further notice. The extent and value of the discovery have still to be proved. From other sources it is gathered that the deposits are on the face of cliffs along a river. Nitrate deposits are known to exist in other parts of Southern Africa, including Rhodesia, but they are too small to be of any commercial value.

South African Pitchblende.—There is very little fresh information regarding the results of operations at the property of the South African Radium Company, in Gordonia, Cape Province, but interest has been revised in the venture by the publication here of cable messages from London stating that a committee of the British Cabinet is paying particular attention to developing Empire sources of radium, and it has been suggested that this committee, or the Imperial Institute, should investigate the possibilities of the Gordonia pitchblende deposit, concerning which the Union Department of Mines and Geological Survey seem to have little or no first-hand information. If this discovery had been made in Canada or Australia, Government geologists would have been instructed to report upon it immediately, and the public would have been placed in possession of reliable information as to extent of the occurrence and its value, but hitherto no such action, I am told, has been taken by the Union Government. It is known, however, that Rand geologists have made favourable reports on the Gordonia deposit, and that samples of the ore have been analysed by the Royal Mint, Pretoria, De Beers Consolidated Mines, Kimberley, and Rand firms, which returned highly satisfactory results. The German Radium Company, in Berlin, has also tested the ore, and has offered to handle the whole output. Development work on the deposit is said to be making very good progress, and it is probable that within the next three months a considerable quantity of the ore will be sent to Germany.

Premier Diamond Mine's Tunnel.—The Premier Diamond Mine, near Pretoria, has been described as "the world's greatest glory hole." It is the largest diamond mine ever known, and has produced the biggest diamond ever discovered—the Cullinan, portions of which are now amongst the British Crown jewels. In view of the depth which has now been attained in the open-cast workings, and having regard to the fact that the present main incline cannot be continued indefinitely without encroaching unduly upon the working area which would otherwise be available in the mine, the question of hauling arrangements for the future was recently discussed. After mature consideration of all the circumstances, and viewing the position from every aspect, it was eventually decided, with the concurrence of the Government, which owns 60 per cent. of the mine, to sink an incline tunnel in the country rock outside the mine, on the north side. The dimensions of this incline tunnel are 15 ft. by 7 ft., and it is being sunk on the same grade as the existing main incline, namely 1 in 5. When completed, it will be equipped with mechanical haulage by which means the ground will be hauled

from the mine as at present. The incline tunnel will be driven 4,000 feet in the first instance, and thereafter gradually extended to meet requirements as the depth of the mine increases. It is anticipated that the work will be completed at the end of June, 1930. As soon as the new tunnel is available it will permit of the removal of the block of blue ground in the centre of the mine, between the 360 ft. and 560 ft. levels, containing, approximately, 6,000,000 loads, at present supporting the main haulage incline and approach thereto, a factor which will greatly facilitate future development work and prolong the life of the mine as an open cast proposition for many years.

Transvaal Nickel and Copper Deposits.—Development of the nickel and copper deposits in the norite complex west of the Pilandsberg, Rustenburg district, down to a depth of 350 ft. vertically (at which depth no visible alteration in behaviour is noticeable), has proved them to be no mere surface deposits, but that they appear to have a deep seated origin, and it is also reasonable to suppose, judging from the consistent nickel values obtained right down to the lowest point, that the metal contents will show similar results in depth. Developments to date have also proved that whereas the deposits are not very large individually, they are of sufficient size and quantity to constitute a sound mining proposition, and that there is here the nucleus for a local mining industry which may eventually produce enough of that metal to satisfy the requirements of this country and leave a handsome margin for export purpose.

Mr. E. R. Schoch, M.Inst.M.M., who has been conducting development work on the ore bodies, says that individually they have no direct connection, the one with the other, so far as developed, and are scattered at random along the zone of differentiation. They have been followed along a line of strike of approximately 16 miles. The strongest surface indications have been found on the farm Vlakfontein No. 902, and here most of the exploration and development have been done. In shape, the ore deposits are best described as sausage- or pipe-like bodies, roughly circular in cross section, and generally with no sharply defined walls, the ore in most cases becoming less massive towards the outer periphery. The pipes are more or less vertical, with occasional finger-like offshoots into the country rock. As may be expected in a disturbed area, the ore in places is cut off by faults, but generally speaking the vertical continuity of the ore bodies is remarkable and invites discussion as to their mode of origin. Incidentally the ore bodies are also traversed by diabase dykes. The latter are of more recent age than the deposits themselves, and have scarcely influenced their appearance and texture at the points of contact.

A remarkable feature of the deposits, Mr. Schoch says, is the comparatively uniform distribution of the nickel contents in the ore bodies. The copper varies within wider limits. It is true that there are sections here and there where the nickel values vary considerably, e.g. on the 300 ft. level of No. 4 ore body where values up to 10% were encountered in one section as against 1% in another, but generally speaking they are consistent within reasonable limits, and this augurs well for development at greater depths. The average grade of the ore so far developed is roughly 3·5% Ni and 1% Cu. In this connection it is noteworthy that the Sudbury Ni : Cu ratio is 2·5 : 1 as against 3·5 : 1 at Vlakfontein. The regularity is remarkable in view of obvious heavy leaching action. Assaying reveals secondary enrichment, but the redeposition is very gradual downwards, without perceptible boundary. The underground water level seems to have fluctuated considerably from time to time which largely accounts for this. The present water table is at about 50 ft.

Alluvial Tin in Rhodesia.—It is reported from Salisbury, Southern Rhodesia, that after prospecting a large alluvial tin field for two years the members of a local syndicate known as the Jack Tin Mine, Ltd., have now installed plant and machinery and have commenced operations along the banks of the Mtuka Nuli River, 23 miles north-west of Salisbury. The property embraces both banks of the river for over six miles to a depth on either side of about 300 yards. A monitor is being used to dislodge the overburden to a depth of from three to seven feet where the alluvial tin gravel is found in quantity. For the present 300 or 400 cubic yards will be washed daily. It is estimated that the gravel and over-burden will return 4 lb. weight of tin to the cubic yard, while pannings taken this week go as high as 15 lb. to the cubic yard. Water is plentiful, and five dams have been erected on the river. A trial shipment of over two tons of concentrates has already been sent to London. The syndicate has pegged further ground to

the south of the present proposition, and has now found a tin lode.

South African Geology.—An exceedingly important volume dealing with the geology of the Union of South Africa has been contributed by three leading South African authorities to the "Handbuch der Regionalen Geologie," published at Heidelberg, Germany. The authors of this contribution are Dr. A. W. Rogers and Dr. A. L. Hall of the Union Geological Survey, Dr. P. A. Wagner and Dr. S. H. Haughton. The volume contains many illustrations, a special feature being the full-page outline maps of geological formations, which take the place of the coloured geological maps usually found in works of this nature. Maps showing the physical divisions of the Union and of the platinum deposits of the Bushveld Complex are also included. Dr. Rogers contributes chapters on Morphology, the Geological History of South Africa, the Witwatersrand and Ventersdorp Systems; Drs. Rogers and Hall jointly deal with the Swaziland System, and Dr. Hall with the Transvaal-Nama System, the Bushveld Igneous Complex, and the Waterberg-Matsap System. Dr. Haughton deals with the Cape System, and Drs. Rogers and Haughton jointly with the Karroo and Cretaceous Systems. Dr. Wagner deals with the Kimberlite and other volcanic pipes, and contributes a lengthy chapter on Economic Geology which constitutes the most comprehensive and important account of the economic geology of South Africa hitherto published.

TORONTO

February 14.

Expansion of the Copper Industry.—The notable development of the copper mining industry will be further stimulated by the establishment of two copper refineries in Eastern Canada according to official announcement. The Noranda Mines, Ltd., operating a smelter in the Rouyn area of Quebec in association with the British Metals Corporation, and the Nicholas Company of New York, will erect a copper customs refinery, at or near the city of Quebec, at an estimated cost of $3,000,000. It will be operated by a new company under the name of the Canadian Copper Refineries, Ltd., in which Noranda Mines, Ltd., will retain a controlling interest. The Noranda Smelter is now operating at a capacity of 1,000 tons a day, which will enable the new refinery to receive 100,000,000 pounds of copper per year from that source in addition to customs work. The erection of a zinc refinery in the same locality is also foreshadowed. The other refinery will be erected by the Consolidated Mining and Smelting Company, Ltd., in conjunction with Ventures, Ltd., controlled by the Lindsley interests of New York which has extensive holdings in the Sudbury district of Ontario. It is to be situated somewhere in Eastern Canada but the location has not yet been made public. An electrolytic zinc reduction works is included in the programme. The plants will be designed and built by the metallurgical staff of the Consolidated company, and will be arranged so as to allow extensions being readily and economically made. The only other copper refinery in Canada is that of the Consolidated Mining and Smelting Co. at Trail, B.C., so that hitherto the output of the mines in eastern Canada have had to be shipped across the line for refining in New Jersey.

Porcupine.—The output of the Porcupine gold field during December was valued at $2,030,729, as compared with $1,923,228. The total production for the year amounted to $20,384,341 as compared with $23,681,642 for 1927, a decrease of 14·9%. The Dome Mine is now producing at the rate of about 1,550 tons per day, with a recovery of over $7·50 per ton. The total production of 1928 amounted to $3,914,883, as compared with $4,031,477 for the previous year, operating costs showing a reduction from $4·06 to $3·85. The McIntyre is now treating about 1,500 tons of ore daily, with an average recovery of about $8 per ton. Its plans for expansion are making good progress, and the deepening of No. 11 shaft has resulted in the discovery of some important ore deposits. The Vipond has materially improved its position by the opening up of an extensive ore deposit encountered on the 500 ft. level on which lateral work is being conducted on four levels. This has more than doubled the ore reserves, and justified a comprehensive scheme of development on the unexplored area of the mine. The milling capacity is being increased to 300 tons per day. The Ridgedome Mines which owns 76 claims situated 4½ miles south of Timmins, has begun development operations. Strong veins have been found on the property on one of which a shaft is being sunk, 100 ft. being the first objective. The geological formation is

similar to that of the producing mines of the district.

KIRKLAND LAKE.—The falling off in the yield of the Porcupine mines has been partially counterbalanced by the increase of the Kirkland Lake output from month to month. During December the value of the production was $1,032,007 as compared with $1,016,467 for November. The total production of $12,165,003 for the year showed an increase of 25% over the $9,727,605 for 1927. The average grade of the ore treated in this camp is about $15, with a recovery of nearly $13. New machinery is being installed at the Lake Shore, which in a short time will increase the rate of production to about 1,300 tons daily. Mill heads average about $18 per ton from ore coming largely from development. Good progress is being made with the sinking of the new shaft, which has reached a depth of 1,450 ft. When the objective of 2,000 ft. is reached, a connection will be established on that horizon with the old shaft. The Sylvanite has cut a rich vein 5 ft. in width, coming in from the Tough-Oakes property adjoining, assaying over $400 per ton. At the Kirkland Lake Gold Mine, lateral work at the 3,200 ft. level is giving encouraging results. The diabase dyke which yielded high values on the adjoining Teck-Hughes property is dipping in to the mine, but it will be necessary to carry work to greater depths, possibly to 5,000 ft. At the Wright-Hargreaves the mill is handling about 700 tons of ore daily, and deeper mining is bringing good results, some very high grade ore having recently been encountered in the lower levels. While production at the Teck-Hughes is being steadily maintained the work of shaft sinking is actively progressing, the objective of the Central shaft being 3,000 ft. A good start has been made on the new south shaft which will be put down to 3,600 ft. The mill is treating about 900 tons a day. An investigation into the affairs of the Tough-Oakes-Burnside, undertaken by the Attorney-General's department of Ontario was recently made by J. A. Reid. His report states that the original Tough-Oakes section appears to be definitely worked out, and the development work on the lower levels had led to no important discoveries. The report severely criticizes the manager Alan Stuart and states that inspection of the mine records show a remarkable paucity of data relating to the lower workings. Active work is in progress at the Moffatt Hall, Ritchie, Murphy, Lebel Ore, and other mines in the eastern section of the camp.

SUDBURY DISTRICT.—The merger between the International Nickel Company and the Mond Nickel Company under the name of the International Nickel Company of Canada has now been completed, and is anticipated to result in increased economy and efficiency in operations. Work on the Frood ore body on the 1,600 and 2,400 ft. levels has proved it to be considerably wider and richer than was anticipated by the management. The total output of nickel contained in matte from the smelters of the Sudbury district in 1928, was approximately 45,000 tons or 90,000,000 pounds. The ratio of copper to nickel of the Frood ores, so far as can be seen from developments to date, will be approximately 10 to 6. While maintaining the present rate of nickel output therefore the combined nickel companies will be able to produce approximately 150,000,000 pounds of copper, at the same time. Development at the 225 ft. level of the Falconbridge has confirmed the results of diamond drilling, the ore deposit where intersected showing a width of 73 ft. Systematic sampling over the entire width has commenced. Plans are in preparation for the construction of a 200 ton smelter, which it is hoped to have in operation by the end of the year. A supply of electric power has been contracted for. Sudbury Basin is conducting an active diamond-drilling campaign on its property at Vermillion Lake, where an ore-body of 800 ft. in length has been indicated with good values in copper, lead, and zinc.

PATRICIA DISTRICT.—The new gold camp of Shoniah Lake promises to be the scene of widespread activity during the coming season. Prospecting has been greatly facilitated by the aircraft and traction services. Mining claims have been solidly staked out for a length of approximately 14 miles, over an average width of three miles. The frequency with which gold-bearing veins have been discovered within such a wide territory is a feature characteristic of this section, whereas in the Red Lake field, discoveries were confined to a comparatively limited area, and were not followed by an extended staking boom. The Bathurst is carrying on active development and has encountered high-grade ore on the 200 ft. level. A new hoist has been ordered which will increase the capacity of the mining plant. At the Howey the grade of ore shows encouraging improvement, and higher values

than those obtained from development are indicated by diamond drilling. With the improvement of transportation facilities now being arranged, the company will be enabled to bring in the machinery for its mill, which will have a capacity of 500 tons. Following an investigation into the affairs of the Jackson-Manion, H. E. Harcourt, President of the company, and D. N. Thompson, Mine Superintendent, were arrested and charged with fraud. The case is still pending, the accused being released on bail.

MANITOBA.—Work is being actively carried on at the Sherritt-Gordon and Mandy properties, with satisfactory results. At the Flin Flon no development is at present being undertaken. Work being concentrated on the construction of the hydro-electric development at Island Falls which will supply power to the mine. The tin discoveries recently made in the Lac du Bonnet district are being explored. The Jack Nutt Mines, Ltd., which owns two large groups of claims, has two crews of men at work. The Manitoba Tin Company which owns the original discovery has a force of men engaged in stripping and trenching.

VANCOUVER

February 9.

VANCOUVER ISLAND. — The mineral development of Vancouver Island has been retarded by the immense concession granted to the Esquimalt and Nanaimo Railway Company, a subsidiary of the Canadian Pacific Railway Company, as consideration for constructing the line. Prospectors have spent considerable time in the field, only to find that the claims they have located are within the railway belt and the Government is powerless to give them title to the properties. This has discouraged the individual prospectors, and the railway company has shown no inclination to develop its holdings. Recently, however, this condition has changed to some extent and now a good deal of attention is being given to properties on Vancouver Island, outside the railway belt.

British Metal Corporation recently has bonded the Gabbro group of 23 claims, situated at the southern end of the island and adjoining the Sunloch mine which is controlled by the Consolidated Mining and Smelting Company of Canada. Little development has been done on the property, but, it is contended, surface development has demonstrated that the Sunloch shear zone extends into Gabbro territory, and at one point the underground development in the Sunloch extends up to the Gabbro line. The terms of the agreement have not been made public, but it is known that British Metal Corporation in order to keep alive its option must spend $5,000 per month on development during the next four years. Some of the surface exposures on the Gabbro show heavy mineralization, the chief minerals being pyrrhotite, pyrite, and chalcopyrite. Assays are said to run up to 4% of copper and 0·5% of nickel.

Quatsino Copper-Gold Mines has started to explore its consolidation of 33 claims, situated along the Elk River and adjoining the Old Sport Mine, which is being developed by the Consolidated Company. The company has two diamond drilling crews at work, and is driving a tunnel to open at depth a promising outcrop of copper ore.

Subject to ratification by the shareholders at a special general meeting called for the purpose, Caledonia Mines has given an option on its property, situated near Port Hardy, on the north-east coast of the island, to the Consolidated Company. The terms have not been made public. The company owns six claims, on which a lode 10 to 30 ft. wide and well mineralized with sphalerite and chalcopyrite, has been exposed for 300 ft. by five open-cuts and opened at a depth of 80 ft. by a tunnel and drift.

Pacific Tidewater Mines, which is backed to an unknown extent by British Metal Corporation, has continued the development of the Indian Chief Mine, at Sidney Inlet, on the west coast and the Tyee-Lenora Mine, at Mount Sicker, on the east coast. It has a considerable body of bornite ore developed at the former and zinc-copper ore at the latter.

THE KOOTENAYS.—The Mining Corporation of Canada has purchased a 35% interest in the Monarch and Kicking Horse groups, near Field, the remaining interest being held by Goldfield Consolidated Mines Company. The properties comprise nearly two square miles of mineral claims, situated in rugged country on either side of the Kicking Horse River. They have been under steady development for nearly four years and between 300,000 and 400,000 tons of lead-zinc ore with a low silver content has been developed in three ore-zones, ranging from 60 to 125 ft.

wide. The West Monarch ore zone has an average width of 125 ft., and has been exposed for a length of 700 ft. and depth of 23 ft. It carries 15% lead, 12% zinc, and rather less than two ounces of silver. The East Monarch zone has been exposed for a length of 140 ft. with the face of the drift in ore, 60 ft. in width and 23 ft. in depth. It carries 18% lead, 12% zinc, and two ounces of silver. It is estimated that 50,000 tons having an average of 5% lead, 15% zinc, and three ounces of silver has been developed on the Kicking Horse, on the opposite side of the river to the Monarch. A company under Dominion Charter with 3,000,000 shares of no par value is being formed to take over, equip, and operate the properties. Work on the construction of a 300-ton mill and aerial tramway will be started as soon as weather conditions allow in the spring.

The hydro-electric plant at the Cork-Province mine has been put into operation and the re-modelling of the mill to a flotation plant of 200 tons daily capacity is nearing completion. It is rumoured that plans are under way for a consolidation of the Lucky Jim and Cork-Province properties, but this, though likely, has not been confirmed. The mill at the Lucky Jim has been closed and all available power is being used for mine development. Work is being concentrated on the raise No. 6 to No. 5 levels, a distance of some 600 ft.

Work on the Deadman shoot at the Noble Five continues to open up a really wonderful body of ore. The drift, after exposing a length of 275 ft. with its face in ore, has been stopped. A cross-cut has been started from the main raise to open the shoot 200 ft. above the bottom level, and a raise is being put up on the shoot to meet the cross-cut. The mill is being run at a daily capacity of about 45 tons on ore won in development, the proceeds from this ore is paying for all operating costs. Exceedingly severe weather since the beginning of the year has caused a shortage of water throughout the Kootenays, and necessitated the curtailment of mining at many properties.

Lieut.-Col. H. H. Yuill, president of Reeves-McDonald Mines (a subsidiary of the Victoria Syndicate) of London, reports that a body of ore, which promises to be as big as that opened on the Reeves property, has been opened on the company's O'Donnell property. The cross-cut has passed through 80 ft. of ore, averaging about 2% lead and 5% zinc, and the face of the cross-cut is still in ore. The company has started a main-haulage tunnel, 120 ft. above the Pend d'Oreille River, which will tap the Reeves ore zone at about 4,000 and the O'Donnell ore zone at about 6,000 ft. from its portal, and, if the ore bodies persist in width and value, will develop an immense tonnage of ore.

Bounty on Iron.—The Hon. W. A. McKenzie, Minister of Mines, has introduced a bill at the Provincial Legislature, now in session, which repeals all former bounties on iron and steel and provides for a bounty of $3 per ton on iron made in B.C. from B.C. ore ; $1.50 per ton for iron made in B.C. from foreign ore ; and $1 per ton on steel shapes made from scrap metal. Not more than $2,000,000 is to be paid in bounties on iron and not more than $20,000 per year and $100,000 in all, on steel made from scrap.

BRISBANE

January 16.

The Mount Isa Company.—An extraordinary general meeting of shareholders in Mount Isa Mines, Ltd., held in Sydney last month, sanctioned the proposal of the directors to increase the nominal capital of the company from £1,500,000 to £2,000,000 by the creation of 500,000 shares at £1 each. These new shares are to rank *pari passu* with the present issue, and are to be issued at the discretion of the board. It is the intention of the directors, in order to provide for the erection of the first unit of the treatment mill, which is to have a capacity of 2,000 tons of ore a day, to issue at an early date debentures carrying the right of conversion into shares at the rate of £2 10s. each ; and the proposed new issue will be reserved to meet such rights.

With regard to work on the Mount Isa field, it was reported a couple of weeks ago that the dam under construction to provide a water supply was so far advanced that it could store water to a depth of 20 ft., and the district inspector of mines now states that, unless something unforeseen happens, the job should be completed by next month. When finished, the height of the dam will be about 50 ft. and its length 45 ft. across the gorge of the creek where it is being built. The construction of the dam has been pushed forward as expeditiously as possible in order that water might be conserved when the wet season takes place. Within the last few days news has been received of very heavy rains at Cloncurry and other parts of the district,

and it is considered that these indicate the beginning of the wet period, which usually commences, when it comes at all, about this time. Mr. Charles A. Mitke, consulting mining engineer, of Arizona, U.S.A., who is the Mount Isa Company's adviser on mining methods, arrived at the mines about a month ago.

Queensland Tin Mines.—An important announcement relating to certain groups of tin mines in North Queensland has lately been made. This is that, through the instrumentality of Mr. Fred. G. Brown, who has been interested in mining in this State for very many years, the Whitworth Mining Corporation has decided to acquire and develop the tin mines of Koorboora, in the Chillagoe mineral field, and of Gurrumba and Irvinebank, in the adjoining Herberton field. Mr. Brown, who has recently returned from a visit to England and America, states that in the carrying out of the project the Whitworth Corporation, which has a capital of £350,000, is prepared to spend from £200,000 to £250,000. Koorboora and Irvinebank are old tin-mining centres which have seen a good deal of activity in the past, especially Irvinebank, where the historical Vulcan mine is situated, and where there are tin treatment works which are now owned by the State, and which have been almost idle for several years. The Whitworth Company is already engaged in gold mining in Alaska and in tin mining in South West Africa. The estimate of the corporation's engineer (Mr. B. G. Butterworth) with regard to the Queensland properties is that, with tin at only £200 a ton, they will within a short period return an annual profit of £135,000, which is expected to increase to £286,000 within four years. The company's manager in Queensland (Mr. Albert Travers) is to-day due to arrive in Australia.

The Coal Industry.—The coal industry of Queensland, like that of New South Wales, is undoubtedly in a bad way. The State has immense coal areas, but a market cannot be found for a tithe of the quantity of coal that could be produced if a demand for it existed. One of the principal factors for slackness in the trade is that between 60 and 70 per cent of the ships that once burned coal are now using oil, and no scheme has yet been finalized here for the production of oil from coal. At the same time, as has already been shown, British coal has been landed in South Australia at a cheaper rate than from Newcastle, in New South Wales, while it has also been found to be impossible for Australian coal to compete with that of South Africa, largely because coloured labour is there used.

A discussion that has been going on for some time between the Federal Government, the mine owners, and the men is to be resumed next week in an attempt to evolve a definite settlement of the coal problem, as affecting all the States, by securing an agreement which will admit of a reduction to be made in the selling price. The proposal is to reduce this price by 4s. a ton, so as to bring screened large coal alongside cranes at Newcastle to £1. 1s. Of this amount it is suggested that the State Government should bear half, the colliery proprietors 1s. a ton. and the employees 1s. Hitherto the miners have been against the proposal, but now that they are seeing the effect of present conditions they are weakening in their attitude. It is also planned, if possible, to make a further reduction of 1s. a ton on coal sold overseas and interstate—a reduction which it is anticipated may be met by a bounty from the Federal Government.

New Guinea Gold.—As shown by statistics compiled by the Department of Trade and Customs, gold to the value of £775,386, consisting of 214,152 oz., has been imported into Australia from New Guinea fields since 1925. The quantities and values given are :—

	Oz.	Value. £
1925–26	5,220	15,212
1926–27	71,925	166,416
1927–28	98,852	235,417
July, 1928	872	2,292
August, 1928	24,790	54,930
September, 1928	238	758
October, 1928	12,255	30,461
	214,152	£775,386

The total number of whites on the goldfields is about 100, and about 40 claim-holders are said to be at work. One miner is reported to have won 300 oz. in a day. The aeroplane service instituted in May, 1927, has proved instrumental in reducing transport difficulties between the coast and the fields. A plane recently put on the service is capable of transporting three tons in flight, thus rendering far more expeditious the transport of machinery in sections in the event of an energetic development following determination of the extent and value of the lodes. The time of flight from the coast has been reduced to 40 minutes.

Mr. E. Broughton Jensen, field superintendent of Guinea Gold, N.L., has joined Mr. Leslie Urquhart's New Guinea organization known as the Ellyou Goldfields Development Corporation, Ltd. In connection with the flotation of the latter company, it is stated that Mr. Urquhart is to receive a refund of £54,678, money expended in securing various interests. Mr. Jensen's work will consist of making a survey of the proposed light railway route from the coast to the Bulolo goldfields.

It is reported from the field that testing is being actively continued on the lower leases by Placer Development, Ltd., and in the Edie Creek area by Ellyou Goldfields Development, Ltd., Considerable outlay has been budgetted by these companies for 1929, to be applied to development and testing operations.

Mount Lyell.—At the annual meeting of shareholders in Mount Lyell Mining and Railway Company there was presented one of the most satisfactory balance sheets submitted for some time by directors. This arose partly from the better price ruling of late for copper, and in part from the development of the various enterprises of the company. Operations in the company's electrolytic refinery, which was opened in May last, are stated to have proved most gratifying. Reserves of ore in the North Mount Lyell mine, not including any below 1,200 ft., now stand at 878,000 tons, with the grade of ore at 5·85 per cent copper. Mount Lyell is still the only company producing copper in Australia.

CAMBORNE

February 27.

The County of Cornwall Bill (1929) and its relation to the Mining Industry.—The Cornish mining industry has received a severe shock in the form of certain proposals embodied in sections 120 and 122 of Part VIII of the County of Cornwall Bill. This Bill, which was presumably framed to deal with the alteration of the county boundary, and with the Torpoint ferry, now includes proposals which will interfere with the immemorial rights of the "tinners"—rights which have been jealously guarded for centuries. The offending proposals refer to rivers and streams, the beds of which are not to be dredged except under licence because the flow of the stream will be interfered with. They further enact that no sands, etc., are to be discharged into the rivers nor are they to be dumped in such places where floods might carry them into the rivers. Similar prohibitions refer to putrifiable rubbish and oils and tars.

Needless to say, there is vigorous opposition to these startling proposals, and, on the initiative of the Cornish Chamber of Mines, a joint meeting of representatives of the owners of mines, tin-streams, and china-clay works and of mining and china-clay landlords, was held at Truro at which a resolution was unanimously passed promising stern opposition to the Bill. The following extracts, taken from a letter written by Mr. C. V. Thomas on February 22 to the *Western Morning News*, express the general feeling on the subject :—

> If part VIII of the Bill were to be passed into law it would, in the opinion of the representatives of the Cornish mining industry, seriously and prejudicially affect, if not altogether prevent, the mining industry from being carried on in the county in the manner in which it must of necessity be, and has always been conducted in accordance with the long-established custom judicially recognized . . . It is not easy for us who for so many years have been actively interested in endeavouring to maintain and develop the mining industry of the county to understand why, by the Bill, an attempt is made to put on the mining industry practically the greatest obstacle they ever had.

Cornish Mining Records.—The matter of collecting, preserving and tabulating Cornish mining records has received considerable attention during the past year. It will be remembered that during the visit of the Institution of Mining and Metallurgy to Cornwall last May much prominence was given to this subject, the support of the Institution being obtained tn connection with the appeal of the five Cornish societies to the Mines Department for assistance. Apparently the Secretary for Mines required further evidence, with the result that on February 14 a deputation consisting of Professors Truscott and Lawn, representing the Institution of Mining and Metallurgy, and Messrs. R. Arthur Thomas and Josiah Paull, representing the Cornish societies, was received by Commodore King at the Mines Department, and it is understood that a strong case was made out for Government assistance. The actual result of this final appeal has not yet been announced, but it is significant that in reply to a question on this very subject in the House of Commons Commodore King (the Secretary for Mines) is reported to have said : "I hope the collec-

tion of the old records will be undertaken locally, and I have offered to give any help I can which will not involve an additional charge on public funds."

Such a reply seems to indicate that the position is " as you were ", and that if these records are to be collected the Cornish societies will have to do the work and bear the expense themselves.

MORVAH CONSOLS.—Preliminary reopening work is being carried out at this mine which is situated in the parish of Morvah, about half-way between St. Just and St. Ives. Past records of this mine are very scanty ; in 1873 it is credited with having sold 6 tons of black tin.

PERSONAL

GLENN L. ALLEN, metallurgical engineer with the San Francisco Mines of Mexico, is in London.

REGINALD F. ALLEN has returned from Spain.

ARTHUR J. BENSUSAN has left for West Africa.

JAMES P. BEST has left for Nigeria.

PERCY BONDS has been transferred from Ipswich to the London office of Ransomes and Rapier, Ltd.

RAYMOND BROOKS—who has moved his office to 15, William Street, New York—passed through London on his way from New York to Rhodesia.

S. T. BRUGH has been appointed General Manager of the Penpoll tin smelting works, in succession to the late W. H. R. Allen.

G. W. CAMPION has left for West Africa.

F. DALBY has left for Nigeria.

H. A. EVANS, general manager of the Sulphide Corporation's works at Cockle Creek, New South Wales, is in London.

DR. A. B. EVEREST, formerly of Birmingham University Metallurgical Department, has joined the staff of the Bureau of Information on Nickel, Ltd.

CECIL H. FELDTMANN has left for Venezuela.

W. A. GREIG has been appointed Chief Analyst and Assayer to the New South Wales Department of Mines.

EDWARD HOOPER has returned from South Africa.

A. E. JANES has returned from Nigeria.

C. LEACH is home from Nigeria.

SIR DOUGLAS MAWSON is here from Australia.

WALTER MCDERMOTT and A. E. FORD have joined the Board of Mawchi Mines, Ltd.

PAUL DYER MERICA has been awarded the James Douglas Gold Medal of the American Institute of Mining and Metallurgical Engineers. He is 40 years of age, and for the last ten years he has been superintendent of research for the International Nickel Co.

A. MONTGOMERY, who recently retired as State Mining Engineer for West Australia, has opened an office at Perth to practise as a consulting mining engineer.

WILLIAM RUSSELL, of the Dorr Co., has left for the United States.

W. J. SHEPHARD has left for Australia.

R. O. SIMON has left for Madrid to join the staff of the agents in Spain of the Climax Rock Drill and Engineering Works, Ltd.

CHARLES SNELLING has left for Nigeria.

D. A. SUTHERLAND has left for Egypt.

J. P. FARRAR died somewhat suddenly on February 18, aged 71. He was on the board of several South African mining companies, and served in the South African War, receiving the D.S.O. in 1900.

W. H. R. ALLEN died suddenly on February 25 at the age of 53. He was formerly on the staff of the Straits Trading Co., Ltd., managing the tin smelter at Wellesley, Penang, and came to this country in connection with the erection of the new Penpoll Tin Smelting Works at Bootle, Liverpool, of which he was General Manager. His death was caused by pneumonia.

TRADE PARAGRAPHS

Silica Gel, Ltd., have changed their address to Bush House (West Wing), Aldwych, W.C. 2.

Sullivan Machinery Co., of Salisbury House, London, E.C. 2, have issued particulars of their coal loading machine with particulars of practice at Francisco No. 2 Mine, near Princeton, Indiana.

Ruston and Hornsby, Ltd., of Lincoln, have issued a folder on their No. 4 Universal excavator which may be converted for use as a shovel, dragline, grabbing crane, skimmer scoop, or back-acting trencher.

The Bureau of Information on Nickel, Ltd., of 2, Metal Exchange Buildings, London, E.C. 3, have issued a bulletin on nickel cast iron in theory and practice and a general statement of their services.

Way and Co., Ltd. (tropical, etc., outfitters), inform us that they are incorporating Everitt, Penn and Co., and that the title of the new firm will be **Way and Everitt Penn, Ltd.,** and the address 14 to 15, Panton Street, Haymarket, S.W. 1

Hadfields, Ltd., of Sheffield, have issued a catalogue of manganese steel and other special steels for the wearing parts of ball and tube mills, a folder relating to elevator, conveyor, and creeper links in manganese steel, and another folder relating to steel forgings generally.

Head, Wrightson, and Co., Ltd., of Stockton-on-Tees, have issued a new edition of their booklet devoted to the Akins classifier which was originally designed for a specific separation in the cyanide process and is now of wider application in ore treatment.

Westinghouse Electric International Co., of 2, Norfolk Street, London, W.C. 2, send us a number of leaflets devoted to the following :— Type HR, low speed, sychronous motors, 100-450 r.p.m ; type CS squirrel-cage induction motors ; magnetic starters ; switchboards for mines ; line-starters.

Ceretti and Tanfani S.A., of Milan, have formed an English company under the title of Ceretti and Tanfani, Ltd., with offices at 53, Victoria Street, London, S.W. 1, where inquiries for the following specialities may be made : Aerial ropeways, cable-ways, funicular railways, telphers cranes, hoists.

conveyors and transporters, and grabs. **John Cawley and Co., Ltd.,** of the same address, have been appointed sole selling agents and managers for Great Britain.

Bucyrus-Erie Co., Ltd., of 83, Kingsway, London, W.C. 2, furnish us with particulars of their new excavator (75-B), which is a 2½ yard machine, and intended to fill the gap between their 2 yard and 3 yard machines, while having the speed of the former and a 25 per cent larger output. It is designed for electrical operation, being equipped with Ward Leonard multi-voltage control. The dipper handle is the same length as on the 3 yard machine, but the boom is 6 inches shorter. In the truck frame all propelling gears, except those of the last reduction, which are enclosed within the girder castings of the mounting, are above the bottom clearance of the truck frame—where they cannot be damaged by rocks, stumps, and other obstacles when the machine is moving. The hoist on the 75-B, like that used on other 3 and 4-yard quarry shovels, is a single hitch twin rope, which has proved to be so unusually efficient and

Bucyrus-Erie 75-B Shovel.

economical as compared with a three-part hitch. With only one sheave on the boom and without the padlock sheave at the dipper, the bending of the rope is reduced to a minimum with resulting increased rope life. This efficient hoist permits the use of the power from the motor in doing useful work rather than in overcoming friction of additional sheaves. The main machinery is all mounted on one single steel casting of deep section that forms the forward part of the revolving frame. Pin connected to this front casting and forming a ballast box, is another casting which carries the motor-generator set. Another important feature is the elimination of the clutch and brake in the hoist machinery, providing smoother and faster operation—with less tiring effect on the operator. Regenerative lowering of the dipper on the motor reduces the net power consumption, gives the operator absolute control of the dipper under all conditions and reduces operating costs. The 75-B is a shovel for the medium sized quarry and has the power and strength to handle the toughest kind of digging. Where the duration of the work warrants the use of electric power it is said to be an ideal machine. Equipped with a 3¼ yd. coal dipper it may be used to follow behind 12 and 16 yard stripping shovels for coal loading. It is also available as a dragline excavator.

THE BRAND SYSTEM OF PULVERIZED FUEL FIRING

This system while being specially applied to marine boilers is equally applicable to Lancashire and water-tube boilers. It is brought to the notice of the readers of The Mining Magazine in virtue of the fact that it introduces a new proposal in this method of firing and affords thus a further advance in the solution of power generation problems.

Broadly speaking, the system is divisible into two parts: That which provides for the crushing of the solid fuel on board ship and its firing to the boilers on a modification of the unit system (as it is generally called); and that which provides for crushing on shore and the transference of the pulverulent material (be it coal or semi-coke) into the ship's bunkers. The latter has the obvious advantage that it enables solid fuel to be handled just as oil is

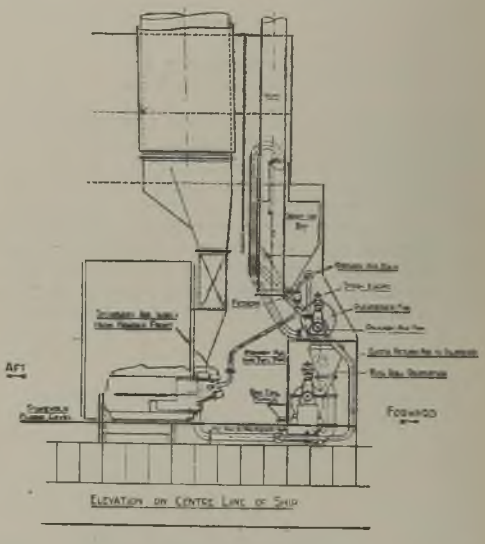


Fig. 1.—Brand System as Applied on Board Ship.

handled to-day. It has the obvious disadvantage that many solid fuels (notably bituminous coal) are liable to spontaneous combustion when in the pulverized form. Captain Brand claims to overcome the last-named obstacle by means of a system of sealed bunkers, from which, before the powdered fuel is pumped into them pneumatically, the air is displaced by means of cold furnace or inert gases which contain but little free oxygen. The powdered fuel, which when crushed will also have been dried, is conveyed from the main (sealed) storage bunker to the burners by way of a "ready-use bin" and by means of a system of screw-conveyors and "fluffing" pipes. The latter term is used to describe the use of cold furnace gases to aerate the powdered fuel and thus make it amenable to pneumatic conveying.

In Fig. 1 is reproduced a section of a system for marine boiler firing with pulverizer on board, which is self explanatory. It may he added, however, that the pulverizer at present recommended is the Rema mill which will be described in a subsequent issue.

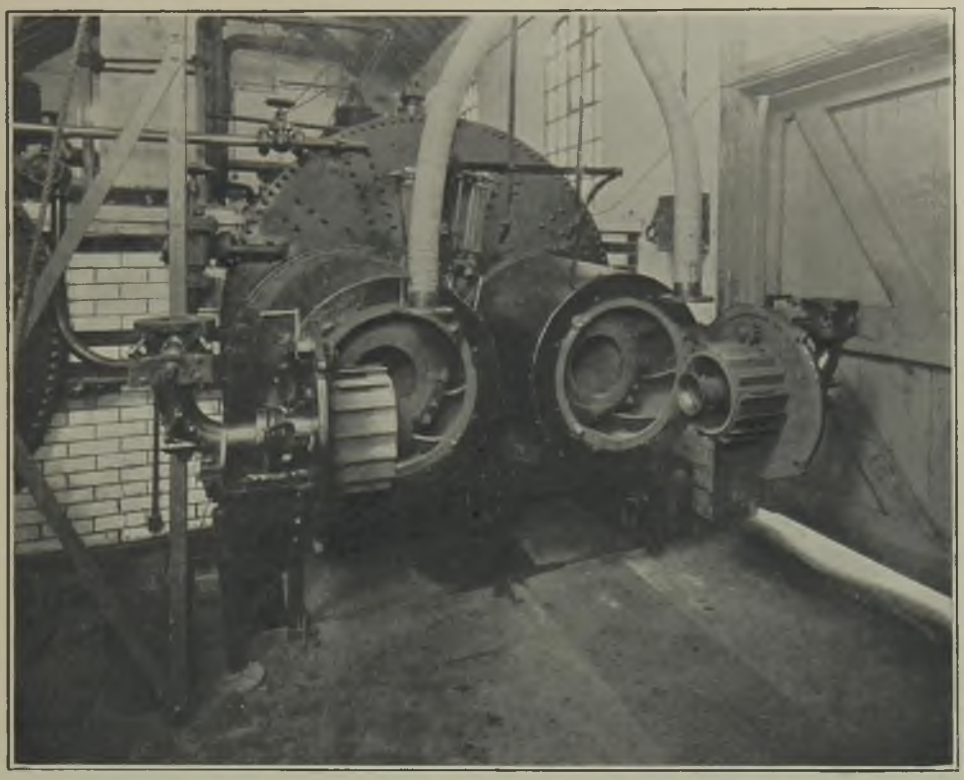


FIG. 2.—BRAND BURNERS, OPENED TO SHOW SPIRALS AND VANES.

In Fig. 2 is reproduced a photograph of the Brand burner which is specifically designed to give a short and turbulent flame. It will be noted that the burner instead of being affixed direct to the boiler furnace is separated therefrom by a cylindrical projection which is called the pre-furnace. The primary and secondary air and the fuel all meet at the centre of the burner and are given a whirling motion by means of the spiral at the burner mouth, where combustion takes place. Combustion should be complete before the flames enter the furnace proper, slag being deposited in the pre-furnace.

THE RUTHS STEAM ACCUMULATOR

The Ruths accumulator is based on the principle of storing the heat energy of steam in a large quantity of water under pressure and at saturation temperature, and releasing this energy in the form of steam produced by ebullition under a reduction in pressure. This principle is not a new one, and was employed by Prof. Rateau for the purpose of utilising, over very short periods, the intermittent exhaust from steam engines. The Rateau accumulator did not, however, protect the boilers against fluctuating demands, whereas the Ruths accumulator provides for storage capacity capable of accommodating wide variations in steam consumption over periods of several hours, if necessary.

The accumulator is built in the form of a cylindrical shell with hemispherical ends. Its volume is so large in comparison with its exterior surface that an insulation of 3 to 4 inches in thickness is sufficient to reduce the heat loss to a negligible quantity even if it is installed in the open air without building protection, as is usual. In point of fact, the radiation loss is usually less than 0·2 B.Th.U's per sq. ft. of exposed surface, per hour, per degree Fahrenheit temperature difference. The plant consists of two parts: The accumulator proper; and the automatic valves which ensure the co-operation of the boilers and the accumulator, and govern the steam distribution throughout the works. Fig. 1 shows a complete accumulator installation. The tank A is constructed of riveted steel plates covered with non-conducting material B. The riveted seams of the shell are covered with insulating blocks C, easily removable for inspecting the joints. The insulation is protected by a suitable cleading D.

The non-return valve E admits charging steam to the internal steam distribution pipe F and the charging nozzles G, which are equipped with circulating pipes H to ensure uniform and noiseless heating of the water. Discharge of the steam takes place through a non-return valve I. A de Laval nozzle K limits the maximum discharge of steam from the accumulator to an amount which will not cause priming in the event of a rupture occurring in the steam main. A water column and feed valves are provided for indicating and adjusting the water level in the accumulator. In operation, the accumulator is filled with water to about 90% of its total capacity. Condensation of steam in the accumu-

lator, due to radiant heat loss, tends to increase the average water level, but the fact that the accumulator discharges steam at a lower pressure than the charting pressure, and steam having a lower heat content, almost exactly counterbalances the condensation effect, so that a readjustment of the water level is seldom required. The accumulator shell is usually supported by four cast-steel brackets so placed as to distribute the bearing reactions properly and provide for the free expansion of the shell under the wide variations of pressure and temperature to which the accumulator and its contents are exposed.

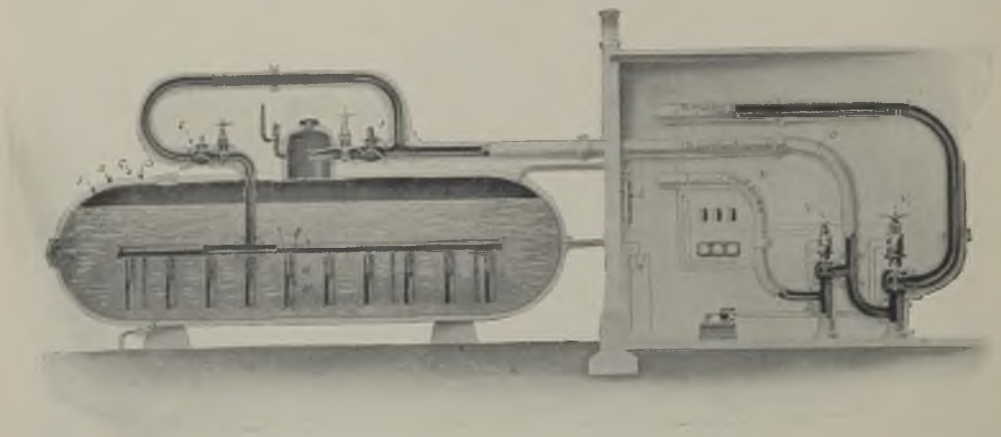


FIG. 1.—DIAGRAMMATIC SECTION OF RUTHS STEAM ACCUMULATOR INSTALLATION.

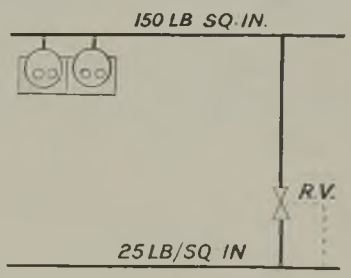


FIG. 2.

One supporting bracket is rigidly fixed, while two others rest on rollers, one permitting longitudinal and the other lateral displacement. The fourth is a pendulum support allowing displacement in either direction.

The stages in the development of automatic control were as follows :—Fig. 2 shows an arrangement frequently employed in industrial plants. Steam is generated in the boiler house at a pressure of, say, 150 lb. per sq. in. and part of this is passed to process through the reducing valve RV at, say, 25 lb. per sq. inch. Due to fluctuating steam demand either on the high-pressure or low-pressure lines, the boiler pressure cannot be kept constant. Ruths' idea, in theory, was to insert an overflow valve OV, Fig. 3, which passes only enough steam to maintain a constant pressure in the high-pressure range. In most cases, however, the steam supply through OV and the steam demand through RV are not equal, and there is a difference in time period between them. A steam accumulator is therefore necessary between OV and RV capable of storing enough steam to maintain the balance. If the pressure in the accumulator drops to 25 lb. per sq. in., and there is still a demand for steam, in excess of the supply from the boilers, the low pressure will drop below 25 lb. per sq. inch. To prevent this, a reducing valve RV is connected in parallel with OV, as shown in Fig. 4, capable of by-passing sufficient steam to maintain the low pressure regardless of the condition of OV. Where the accumulator is built for a lower

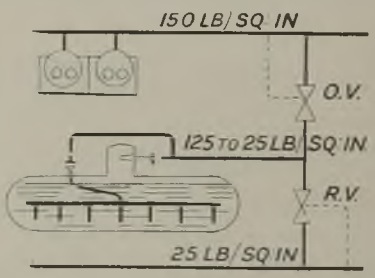


FIG. 3.

pressure than that of the boilers, for instance, 125 lb. per sq. in. as in the case indicated, a master-valve or limit-valve, MV Fig. 5, is required which will protect the accumulator against excessive pressure rise due to overcharging. This throttles the supply of steam if the accumulator pressure reaches 125 lb. per sq. in. regardless of the condition of the valves OV and RV. By using these four valves, absolute balance and constant pressure are maintained both in the high-pressure and low-pressure lines over the range of conditions for which the particular plant has been designed.

In practice the arrangement as shown in Fig. 5 has been improved by combining in a single valve all the functions of the valves OV, RV, and MV. In Fig. 1 it will be seen that the steam switchboard consists of two automatic regulating valves V_1 and V_2 which control the charging and discharging of the accumulator and maintain a constant

pressure in the factory steam mains. These two valves fulfil all the functions of the four valves shown in Fig. 5. In the case indicated in Fig. 1, Valve V_1, is connected to the boiler main N, and is controlled by the boiler pressure. It acts as an overflow valve, being set for a pressure slightly lower than the safety valves. By this means the popping of the safety valves on the boilers is avoided, and when

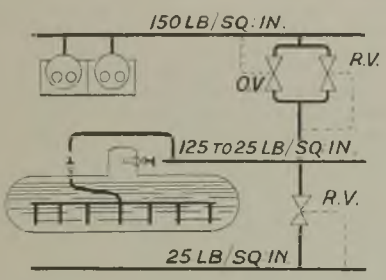


Fig. 4.

steam is generated in excess of the pressure for which valve V_1 is adjusted it will automatically pass through this valve into the accumulator line O. In this way the boiler pressure is kept constant. The reducing valve V_2 maintains a constant pressure in line P leading to the steam consumers. The accumulator will be charging or discharging according to whether more or less steam is passed through valve V_1 than through valve V_2 at a given moment. If the accumulator is fully charged, V_1 acts as a maximum pressure valve and will shut off further steam supply to the accumulator. On the other hand, if the accumulator is completely discharged, V_1 acts as a reducing valve, securing a sufficient supply of steam

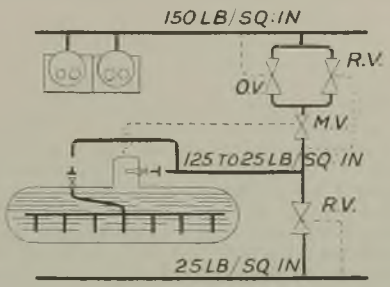


Fig. 5.

to the secondary steam line P, despite the fact that the accumulator is run down. It is only in the latter event, or when the accumulator is fully charged and excess steam is still being generated by the boilers, that the rate of firing need be altered. In a properly designed plant this will only rarely occur.

BRITISH INDUSTRIES FAIR

The British Industries Fair was held from Feb. 18 to March 1, the engineering and heavy industries at Birmingham (Castle Bromwich) and the other trades (including Chemicals) in London (White City). Among exhibits in the Birmingham section likely to be of interest to mining engineers we noticed the following :—

Davidson and Co., Ltd., of Belfast, were showing " Sirocco " mine fans among others.

Fielding and Platt, Ltd., of Gloucester, had a display of horizontal semi-Diesel engines.

N. Hingley and Sons, Ltd., of Dudley, exhibited mining chains and other colliery requisites.

George Ellison, of Birmingham, had a representative collection of switchgear for all purposes.

Carron Co., Carron, Stirlingshire, as an example of their engineering products, displayed a colliery haulage gear.

Brown Bayley's Steel Works, Ltd., of Sheffield, were showing a wide variety of their products in stainless steel.

John Henry Andrew and Co., Ltd., of Sheffield, were showing many examples of their steel products including mining drills.

Foster Instrument Co., Ltd., of Letchworth, were showing a variety of pyrometers and temperature controlling instruments.

Winget (1924), Ltd., of 24, Grosvenor Gardens, London, S.W. 1, were represented by stone breakers and granulators among other exhibits.

Alfred Herbert, Ltd., of Coventry, were making a feature of their Atritor coal pulverizer, which has already been described in these columns.

R. and J. Dick, Ltd., of Glasgow, had a representative collection of Balata belting for driving or conveying, together with other similar specialities.

Robert Warner (Pumps), Ltd., of Newcastle-on-Tyne, were showing horizontal and vertical ram pumps of different sizes and a small miner's hand pump.

British Goodrich Rubber Co., Ltd., of 50, Pall Mall, London, S.W. 1, exhibited rubber compounds capable of resisting abrasion, and pump and valve linings.

Reavell and Co., Ltd., of Ipswich, exhibited their well known air-compressors both vertical single acting and double acting (two-stage) and rotary types.

Tubes, Ltd., and **The Bromford Tube Co., Ltd.,** both of Birmingham, were showing on adjoining stands a wide variety of weldless steel tubing suitable for all purposes.

The Whitecross Co., Ltd., of Warrington, had samples to show the stages in process of the manufacture of steel wire ropes including locked coil and flattened strand varieties.

Lacy-Hulbert and Co., Ltd., of Beddington, Surrey, showed several air-compressors and vacuum pumps both fixed and portable types for electric or petrol engine drives.

United Steel Companies, Ltd., of Sheffield, incorporating a number of steel, iron and coal companies in that district, had a comprehensive collection of their various products.

The Consolidated Pneumatic Tool Co., Ltd., of 170, Piccadilly, London, W. 1, had a wide range of pneumatic tools on exhibit together with a portable compressor in operation.

Norris, Henty and Gardners, Ltd., of Manchester, exhibited horizontal cold starting oil engines 7–8, 29–31, and 105–112 b.h.p. and one vertical engine, 4 cylinder, 152 b.h.p.

Stewarts and Lloyds, Ltd., of Birmingham, were showing tubes in wrought iron and steel for gas, steam, water, and compressed-air, together with fittings, including the Victanlic joint.

Cable Makers Association, of Sardinia House, Sardinia Street, London, W.C. 2, displayed a wide selection of electric cables, the products of the works of their various constituent companies.

Broom and Wade, Ltd., of High Wycombe, had an outdoor exhibit of a number of portable and stationary air-compressors, both rotary and reciprocating types and all in operation.

Electric Furnace Co., Ltd., of 17, Victoria Street, London, S.W. 1, exhibited Ajax Wyatt and other furnaces for metal melting including the new Ajax Northrup high-frequency induction furnace.

Stewarts and Lloyds, Ltd., of Birmingham, exhibited a range of lap-welded wrought iron and steel and weldless steel tubes and fittings, together with bitumen lined and concrete lined steel tubes.

Marshall, Sons and Co., Ltd., of Gainsborough, exhibited a 60 b.h.p. vertical oil engine, a 16 b.h.p. horizontal engine (two-stroke) and one each of a 30 and 15 b.h.p. new type, four stroke, horizontal engine.

George Angus and Co., Ltd., of Newcastle-on-Tyne, showed canvas hose with a bursting pressure of 700 lb. per sq. in. in 2½ in. hose. Also brake linings, beltings (driving and conveying) and leathers.

The Beldam Packing and Rubber Co., Ltd., of 16, Gracechurch Street, London, E.C. 3, presented a comprehensive range of packings and jointings for all purposes and also beltings and other mechanical rubber goods.

Peter Brotherhood, Ltd., of Peterborough, exhibited a 300 h.p. 6 cylinder, Brotherhood Ricardo high-speed Diesel engine direct coupled to a 200 k.w. 440 volt G.E.C. generator. The engine is of the sleeve valve type.

F. C. Hibberd and Co., Ltd., of 16, Northumberland Avenue, London, W.C. 2, in an outdoor exhibit were making a feature of the Planet locomotive for all rail gauges and of 10, 20 or 40 h.p. to run on petrol, paraffin, or crude oil .

The Coventry Chain Co., Ltd., of Coventry, had a representative exhibit to show the many applications of chain drives—which are used as couplings between prime mover and mills, fans, etc. Also conveyors and elevators.

Thos. Firth and Sons, Ltd., of Sheffield, presented a large and representative exhibit showing the many and varied uses to which stainless and " Staybrite " steels can be put, including tubes, wire, foil, and heavy castings and forgings.

The General Electric Co., Ltd., and **Fraser and Chalmers Engineering Works,** of Magnet House, Kingsway, London, W.C. 2, on a large stand were showing a wide selection of their products including Witton generating machinery and switchgear.

National Gas Engine Co., Ltd., of Ashton-under-Lyne, had a representative display of vertical and horizontal gas, crude oil and petrol and paraffin engines such as are made in sizes ranging from 2 to 2,000 h.p. for dynamo, pump, or compressor driving.

Hadfields, Ltd., of Sheffield, exhibited samples of their products in Era/H.R. heat-resisting steels, in Era/CR. non-corroding steels, and in Resista H.Y. steel which is both heat and corrosion resisting. Reference was made to their large output of crushing machinery.

Rushton Tractors, Ltd., of Feltham, Middlesex, had an outdoor exhibit of their tractor which has been designed for hard colonial service, and in which is incorporated an air cleaner and special vapourizer which allows of the use of an inferior kerosene fuel.

G. A. Harvey and Co. (London), Ltd., of Woolwich Road, London, S.E. 7, were exhibiting pressed steel plate work, perforated metal screens and trommels, and woven wire screens. In the former are included tanks, bins, hoppers, etc. Also steel filing cabinets and lockers.

Barium Consolidated, Ltd., associated with The Anglo-Oriental Mining Corporation, Ltd., of 31 to 33, Bishopsgate, London, E.C. 2, were displaying in the London section samples of the raw material and its products. The Company are working a property in Sligo district, Ireland.

The Bureau of Information on Nickel, Ltd., of 2, Metal Exchange Buildings, London, E.C. 2, staged a comprehensive exhibit to illustrate the properties and uses of nickel and its alloys together with information as to the services which the Bureau offers without charge or condition.

J. and F. Howard, Ltd., of Bedford, were making a feature of their petrol or crude oil locomotive which is made in gauge sizes from 1 ft. 4 in. to 5 ft. 3 in., and capacities of from 20–28 to 61–81 b.h.p. with corresponding drawbar pulls (in lb.) of 1,200 slow and 850 fast and 6,300 slow and 1,350 fast.

Tangyes, Ltd., of Birmingham, exhibited a 144 b.h.p. twin-cylinder heavy fuel oil engine (cold starting) and a 19 b.h.p. engine and a 6 b.h.p. engine (lamp starting) connected to a treble ram pump, together with a number of other pumps of their manufacture and lifting jacks, pulley blocks, malleable castings, and leathers.

Crossley Bros., Ltd., of Openshaw, Manchester, were showing a 4-cylinder vertical compressorless Diesel engine of 110 b.h.p. direct coupled to a Crompton-Parkinson d.c. generator of 72 k.w., 440 volts. Also a compressed-air starting set and twin-cylinder enclosed horizontal oil engine, developing 44 b.h.p. at 375 r.p.m.

Ruston and Hornsby, Ltd., of Lincoln, exhibited a No. 4 excavator adapted as a back acting trench digger, a 20 b.h.p. cold-starting horizontal oil engine, a 3-cylinder vertical engine of 100 b.h.p., a " Thermax " vertical boiler and a selection of small pumps. All these specialities are sufficiently well-known to readers to need no amplified description.

Canadian Government Exhibit.—For the first time at this fair, a Dominion or Colonial Government has participated in a separate section. In both the Birmingham and London fairs an exhibit representative of the products of the Dominion of Canada was staged. This included *inter alia* examples of the metal and mineral output and displays by the two great railway companies.

Blackstone and Co., Ltd., of Stamford, Lincs., were exhibiting a variety of their oil engines including one of 150 b.h.p. and one of 65 b.h.p., a complete electric generator plant driven by a 64 b.h.p. engine. Also, on a separate stand, a new crude oil engine suitable for locomotives in sizes of 52, 35 and 17½ b.h.p. All these engines are for heavy fuel oil and work on the spring injecton principle.

Braithwaite and Co., Engineers, Ltd., of Broadway Buildings, London, S.W. 1, had both an interior stand and an outdoor exhibit. In the former were photographs and models exemplifying their structural steelwork including tanks, transmission towers, tunnel linings, and mine tubs. At the latter was an exhibit designed to show the strength of a transmission tower, from which a railway truck was suspended.

Davey, Paxman and Co., Ltd., of Colchester, were showing two vertical crude-oil engines, one of 50–57 b.h.p., twin cylinder, and the other of 160–184 b.h.p., four cylinder. The fuel injection is of the same kind as that used on Blackstone horizontal engines described elsewhere. Separate parts were also shown, one being sectioned to indicate its working. An all-steel sectional boiler was also exhibited.

Imperial Chemical Industries, Ltd., of Imperial Chemical House, London, S.W. 1, were represented at both sections of the fair. In the London section on a large stand were departments devoted to the various products of this organization and its subsidiaries, notably a display of explosives and accessories for electric shot firing by **Nobel Industries, Ltd.** A film was also being shown at intervals demonstrating quarry blasting operations as employed by the Buxton Firms Co., Ltd. Portland cement is another product. In the Birmingham section Crawshaw's Chemical Collander referred to in these columns on a previous occasion, was on exhibit.

METAL MARKETS

Copper.—Earlier price advances were eclipsed during February, when electrolytic soared from 17.25 cents to 19.50 cents per lb. The rise took place under conditions of great market activity and feverish excitement, accompanied by manipulative tactics in standard copper on the part of speculative operators. With copper so dear, however, it is certain that industrial demand will be checked, whilst production will undoubtedly be stimulated, so that sooner or later stocks, which are at present very small, should be added to. A danger factor in the position is the possibility that consumers have overbought, creating the likelihood of resales.

Average price of cash standard copper: February, 1929, £78 5s. 10d.; January, 1929, £75 11s. 11d.; February, 1928, £61 14s.; January, 1928, £61 18s. 11d.

Tin.—This market was very steady during February. Industrial demand was quiet and such activity as was displayed by the "bull" group was merely directed to supporting prices at the existing level. American trade indications are hopeful, however, so that later on bigger buying may materialize from that direction. With world production still going ahead and "visible supplies" expanding further—February witnessed an increase in the latter of some 2,000 tons—it is difficult, nevertheless, to take a really optimistic view of the immediate outlook.

Average price of cash standard tin: February, 1929, £223 4s. 8d.; January, 1929, £222 16s. 3d.; February, 1928, £233 18s. 10d.; January, 1928, £253 6s. 5d

Lead.—There was a tendency towards rather firmer conditions during February, though trade buying remained somewhat quiet. Arrivals were short, and this was probably the reason for the maintenance of prices, whilst there was also an inclination to take a hopeful view of the outcome of the proposed producers' meeting in March. On the Continent deliveries were adversely affected by the severe frost, which hindered and in many cases entirely suspended canal and rail traffic.

Average mean price of soft foreign lead: February, 1929, £23 2s. 10d.; January, 1929, £22 4s. 6d.; February, 1928, £20 10s. 3d.; January, 1928, £21 19s. 10d.

Spelter.—This market was steady. Demand was dull, but on the other hand producers were not inclined to press sales. It was significant, however, of the poor position that, although supplies were held up by the frosty weather, there was no effort at any "bull" movement. The undertone seems nevertheless fairly good, owing to the evidence that producers are seriously going ahead with their programme of output curtailment, which is to be maintained at 10% during March.

Average mean price of spelter: February, 1929, £26 5s. 11d.; January, 1929, £26 4s. 3d.; February, 1928, £25 10s. 2d.; January, 1928, £26 1s. 9d.

Iron and Steel.—Conditions improved considerably on the Cleveland pig-iron market during February, and makers advanced their prices by 1s., making quotations as follows: No. 1 Cleveland foundry, 69s. 6d.; No. 3 G.M.B., 67s.; No. 4 foundry, 66s., and No. 4 forge, 65s. 6d. Consumers displayed more readiness to enter into forward commitments. Hematite was also firm and rather scarce, with the quotation for East Coast Mixed Nos. well maintained at 72s. 6d. In finished iron and steel fresh demand was quieter, but many works, particularly those engaged on ship steel, were quite actively employed.

Iron Ore.—The even tenour of the market was upset by the severe weather on the Continent in February, which stopped the movement of supplies down the Rhine and in certain other directions. However, most works had moderate stocks on hand and no serious shortage seems to have occurred. Fresh business remains small, owing to the well-booked condition of both mines and users, and prices are somewhat nominal, with best Bilbao rubio around 22s. 6d. per ton c.i.f.

Antimony.—A good business is passing in English regulus, with the price steady at about £54 to £55 per ton. Chinese regulus has been quiet; material on spot is about £38 per ton ex warehouse, whilst for shipment from China the current value is about £33 10s. c.i.f.

Arsenic.—The market has ruled quietly steady, with 99% Cornish white priced at £16 to £16 5s. per ton according to quantity, f.o.r. mines.

Bismuth.—No change has occurred in the official price, which stands at 7s. 6d. per lb. for merchant lots.

Cadmium.—Some temporary easiness was witnessed in the price of this commodity recently, as demand slackened for a time and the liquidation of merchant parcels weakened prices. Latterly, however, there has been a better tone again and the current price may be called about 4s. 1d. to 4s. 2d. per lb.

Cobalt Metal.—Quite a brisk inquiry has been seen, but the official price of 10s. per lb. is shaded for good contracts.

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.		Cash.	3 Months.	Near.	Forward.
Feb.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.	£ s. d.
11	77 2 6	77 8 9	84 0 0	84 10 0	84 10 0	—	—		224 10 0	225 10 0	26 2 6	26 6 3
12	76 10 0	77 0 0	83 10 0	84 10 0	84 10 0	81 10 0	82 15 0		224 15 0	225 5 0	26 2 6	26 6 3
13	76 7 6	77 0 0	83 10 0	84 10 0	84 10 0	—	—		224 10 0	225 0 0	26 2 6	26 3 9
14	76 7 6	77 0 0	83 10 0	84 10 0	84 10 0	—	—		224 5 0	225 7 6	26 3 9	26 3 9
15	76 7 6	77 2 6	83 10 0	84 10 0	84 10 0	81 5 0	82 10 0		224 0 0	224 15 0	26 5 0	26 5 0
18	76 5 0	76 18 9	83 10 0	84 10 0	84 10 0	—	—		220 15 0	221 10 0	26 3 9	26 5 0
19	76 10 0	77 3 9	83 10 0	84 10 0	84 10 0	81 5 0	82 10 0		223 0 0	223 15 0	26 1 3	26 3 9
20	76 17 6	77 10 0	83 10 0	84 10 0	84 10 0	—	—		222 0 0	222 17 6	26 2 6	26 6 3
21	77 1 3	77 16 3	84 0 0	84 10 0	84 10 0	—	—		221 17 6	222 17 6	26 2 6	26 5 0
22	77 16 3	78 11 3	84 0 0	84 10 0	84 10 0	81 15 0	83 0 0		220 10 0	221 10 0	26 5 0	26 5 0
25	78 3 9	78 17 6	84 0 0	84 10 0	84 10 0	—	—		221 12 6	222 12 6	26 6 3	26 6 3
26	79 13 9	80 7 6	85 0 0	85 15 0	85 15 0	83 0 0	84 5 0		220 12 6	222 12 6	26 6 3	26 5 0
27	81 5 0	82 3 9	86 10 0	87 10 0	87 10 0	—	—		220 12 6	222 12 6	26 6 3	26 5 0
28	82 12 6	83 12 6	88 10 0	89 10 0	89 10 0	—	—		220 5 0	222 12 6	26 7 6	26 8 9
Mar.												
1	83 12 6	84 16 3	89 10 0	90 10 0	90 10 0	86 15 0	88 0 0		220 2 6	222 10 0	26 5 0	26 10 0
4	82 7 6	83 12 6	91 0 0	91 10 0	91 10 0	—	—		219 15 0	222 10 0	26 8 9	26 12 6
5	83 10 0	84 13 9	91 0 0	91 10 0	91 10 0	87 5 0	88 10 0		220 0 0	222 10 0	26 7 6	26 11 3
6	82 10 0	83 17 6	91 0 0	91 10 0	91 10 0	—	—		219 5 0	221 5 0	26 3 0	26 10 0
7	82 10 0	83 17 6	91 0 0	91 10 0	91 10 0	—	—		218 12 6	220 10 0	26 2 6	26 8 9
8	82 5 0	83 12 6	91 0 0	91 10 0	91 10 0	87 10 0	88 15 0		220 0 0	220 10 0	26 2 6	26 11 3

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

Cobalt Oxides.—There is no change to report, black oxide selling at 8s. per lb. and grey at 8s. 10d.

Platinum.—Demand has taken a turn for the better recently and, although prices are unchanged at £13 17s. 6d. per oz. for refined metal, the tone is much better.

Palladium.—A small improvement is noticeable in sympathy with platinum, but generally speaking the market is not particularly active. Prices still range from £9 10s. to £10 10s. per oz.

Iridium.—The market remains quietly steady, sponge and powder being priced at £57 to £60 per oz.

Selenium.—A steady business continues in high grade black powder at 7s. 8d. to 7s. 9d. per lb. ex warehouse.

Tellurium.—This is an idle market and prices are nominal at around 12s. 6d. to 15s. per lb.

Manganese Ore.—Apart from a few odd lots which have been sold on the Continent business has been slow and most of the larger users seem tolerably well covered for some time ahead. Prices are around 1s. 2d. per unit for first quality ores and 1s. to 1s. 0½d. per unit c.i.f. for ordinary grades.

Aluminium.—This market wears a very steady appearance and prices are unchanged at £95, less 2%, delivered.

Sulphate of Copper.—The strong copper market has naturally resulted in firmer conditions in this commodity and English material is now held for about £28 10s. to £29, less 5%.

Nickel.—A good business continues, with prices about £170 to £175 per ton.

Chrome Ore.—About £4 5s. to £4 7s. 6d. per ton remains the price of 48% Rhodesian, while Indian and New Caledonian are rather dearer.

Quicksilver.—Latterly there has been a small improvement in inquiry, but the market can hardly be called active. Spot material stands at about £22 2s. 6d. to £22 5s. per bottle.

Tungsten Ore.—Business has not been particularly brisk, but sellers remain rather reserved owing to having little to offer for the time being, and prices seem quite firm at around 19s. to 19s. 6d. per unit c.i.f. for forward shipment from China.

Molybdenum Ore.—For 85% Australian concentrates about 34s. to 34s. 6d. per unit c.i.f. is named.

Graphite.—A steady demand is maintained, with prices unchanged at £25 to £27 per ton c.i.f. for 85 to 90% Madagascar flake and £22 to £24 c.i.f. for high grade Ceylon lumps.

Silver.—On February 1 spot bars stood at 26 5/16d. India bought early in the month, but with the Chinese new year holidays and riots in Bombay quieter conditions prevailed and in the absence of support prices receded to 25⅞d. on the 16th ult. Later in the month India again appeared as a moderate buyer and, although America proved a more ready seller, prices recovered somewhat and on February 28 spot bars closed at 26⅛d.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
April, 1928	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
Total, 1928	9,908,188	451,408	10,359,596
January, 1929	840,344	36,108	876,452
February	778,559	36,725	815,284

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
February 29, 1928	197,340	16,590	4,668	209,774
March 31	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	190,870	16,803	4,889	216,628
December 31	187,370	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

TRANSVAAL GOLD OUTPUTS.

	January.		February.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	84,500	£134,547	80,800	£131,315
City Deep	91,500	23,875	83,000	22,033
Cons. Main Reef	60,500	22,199	53,000	20,759
Crown Mines	208,000	68,105	195,000	65,497
D'rb'n Roodepoort Deep	40,300	14,037	35,300	12,598
East Rand P.M.	140,500	37,715	132,000	35,162
Ferreira Deep	32,000	5,358	30,400	4,921
Geduld	85,500	26,755	79,500	24,978
Geldenhuis Deep	63,000	14,483	55,000	13,302
Glynn's Lydenburg	6,200	1,960	5,200	1,635
Government G.M. Areas	208,000	£400,810	187,000	£363,220
Kleinfontein	53,100	11,387	48,400	10,845
Langlaagte Estate	83,000	£110,095	76,000	£104,161
Luipaard's Vlei	24,000	5,933	21,200	5,421
Meyer and Charlton	17,200	£18,946	16,200	£18,329
Modderfontein New	147,000	73,714	133,000	68,386
Modderfontein B	71,500	26,761	64,000	24,559
Modderfontein Deep	45,700	24,056	41,800	22,117
Modderfontein East	65,000	20,020	61,000	19,072
New State Areas	78,000	£138,490	71,000	£129,184
Nourse	61,000	16,752	57,000	16,327
Randfontein	207,000	£207,098	191,000	£189,123
Robinson Deep	77,000	21,924	67,000	19,844
Rose Deep	55,800	11,622	50,300	10,722
Sabie	3,600	£3,515	3,220	793
Simmer and Jack	74,300	21,924	67,500	17,236
Springs	72,000	£147,605	64,000	£132,001
Sub Nigel	23,700	22,515	23,400	21,197
Transvaal G.M. Estates	14,620	4,531	13,320	4,636
Van Ryn	39,000	£40,555	37,000	£38,636
Van Ryn Deep	66,000	£107,053	60,000	£99,268
Village Deep	59,000	15,535	55,000	14,468
West Rand Consolidated	86,000	£90,766	77,000	£82,737
West Springs	63,000	£80,785	57,000	£72,694
Witw'tersr'nd (Knights)	53,000	£45,137	48,000	£42,809
Witwatersrand Deep	43,000	9,828	41,500	9,429
Wolhuter	27,700	6,384	25,900	6,000

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	—
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	44,772	—
Total	593,426	581,428	575,913	46,231

RHODESIAN GOLD OUTPUTS.

	January.		February.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	25,000	11,205	22,000	11,276
Globe and Phœnix	6,029	5,405	6,005	5,119
Lonely Reef	5,300	4,194	5,000	4,066
Rezende	6,400	2,980	6,000	2,911
Shamva	48,500	£26,099	43,900	£23,874
Sherwood Starr	4,800	£7,874	4,600	£7,640

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Victoria.	Queensland.	New South Wales.
	Oz.	Oz.	Oz.
January, 1928	891	3,906	1,336
February	2,276	886	1,108
March	2,098	1,339	4,176
April	2,811	846	318
May	2,990	321	397
June	3,932	498	487
July	3,208	772	154
August	2,637	690	3,447
September	3,366	644	364
October	2,632	820	256
November	3,111	865	—
December	—	—	—
Total	30,952	11,587	12,043

WEST AUSTRALIAN GOLD STATISTICS.

	Reported for Export Oz.	Delivered to Mint Oz.	Total Oz.	Value £
February, 1928	99	32,021	32,120	136,436
March	614	22,989	23,603	100,259
April	213	36,274	36,487	154,986
May	72	29,192	29,264	124,305
June	348	39,101	39,449	167,568
July	184	29,215	29,399	124,877
August	120	37,871	37,991	161,374
September	426	31,871	32,397	137,613
October	75	36,490	36,565	155,317
November	390	31,076	31,466	133,658
December	547	35,550	36,097	153,329
January, 1929	237	27,147	27,384	116,319
February	116	28,061	28,177	119,686

AUSTRALASIAN GOLD OUTPUTS.

	January.		February.	
	Tons	Value £	Tons	Value £
Associated G.M. (W.A.)	3,962	6,527	4,885	7,160
Blackwater (N.Z.)	3,153	5,836	3,400	5,826
Boulder Persev'ce (W.A.)	4,932	14,461	5,869	15,927
Grt. Boulder Pro. (W.A.)	6,633	20,945	8,959	25,385
Lake View & Star (W.A.)	12,709*	21,151*	7,766	11,615
Sons of Gwalia (W.A.)	—	—	13,294	10,596
South Kalgurli (W.A.)	8,303	15,600	8,167	15,038
Waihi (N.Z.)	21,485†	7,230g 34,998s	—	— —

* December and January. † Twenty-nine days. g Oz. gold. s Oz. silver.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	January.		February.	
	Tons Ore	Total Oz.	Tons Ore	Total Oz.
Balaghat	4,000	2,434	3,700	2,356
Champion Reef	9,670	5,263	8,650	5,214
Mysore	18,150	9,111	15,660	8,022
Nundydroog	11,000	6,652	10,300	6,502
Ooregum	14,000	7,381	13,500	7,212

WEST AFRICAN GOLD OUTPUTS.

	January.		February.	
	Tons.	Oz.	Tons.	Oz.
Ashanti Goldfields	9,129	9,537	8,500	9,061
Taquah and Abosso	10,010	£13,771	9,680	£13,287

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	January.		February.	
	Tons	Value £	Tons	Value £
Chosen Synd. (Korea)	7,745	11,143	6,585	9,920
Frontino & Bolivia (C'lbia)	1,950	5,494	1,900	6,319
Gabait (Sudan)	440	1,447	490	935
La Noria (Mexico)	12,463	100,518*d*	—	—
Lampa (Bolivia)	40,000*s*	—	—	—
Lena (Siberia)	—	32,616	—	15,195*
Lydenburg Plat. (Trans.)	3,620	755*p*	3,235	607
Marmajito (Colombia)	710	2,832	540	3,019
Mexican Corp. Fresnillo	88,541	123,550*e*	—	—
Onverwacht Platinum	2,422	476*p*	2,220	475*p*
Oriental Cons. (Korea)	—	81,000*d*	—	69,000*d*
St. John del Rey (Brazil)	10,980	29,800	—	29,000
Santa Gertrudis (Mexico)	49,934	127,695*e*	—	—

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

COPPER, LEAD, AND ZINC OUTPUTS.

		Jan.	Feb.
Broken Hill South	Tons lead conc.	5,933*a*	—
	Tons zinc conc.	5,939*a*	—
Burma Corporation	Tons refined lead	6,502	6,506
	Oz. refined silver	592,042	618,141
Bwana M'Kubwa	Tons copper oxide	907	676
Messina	Tons copper conc.	1,223	983
Mount Lyell	Tons concentrates	—	2,289
Namaqua	Tons copper	190	—
North Broken Hill	Tons lead conc.	6,130	7,200
	Tons zinc conc.	4,860	5,410
Poderosa	Tons copper ore	823	804
Rhodesia Broken Hill	Tons lead	345	355
	Tons slab zinc	821	822
San Francisco Mexico	Tons lead conc.	3,445	3,020
	Tons zinc conc.	4,072	3,606
South American Copper	Tons Matte	—	—
Sulphide Corporation	Tons lead conc.	1,649*b*	2,030*c*
	Tons zinc conc.	2,463*b*	3,024*c*
Tetiuhe	Tons lead conc.	724	586
	Tons zinc conc.	1,213	1,079
Union Minière	Tons copper	9,000	—
Zinc Corporation	Tons lead conc.	5,073	5,084
	Tons zinc conc.	4,188	4,763

a Six weeks to February 9. *b* Four weeks to January 26.
c Four weeks to February 23.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

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

	Tons.		Tons.
July, 1928	5,488	January, 1929	5,840
August	5,499	February	4,896
September	5,071	March	—
October	5,161	April	—
November	5,483	May	—
December	5,249	June	—
Total 1928	61,898	Total 1929	10,736

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	Dec.	Jan.	Feb.
	Tons.	Tons.	Tons.
Ampang	14	14	15½
Chenderiang	24	24	20
Gopeng	77½	80½	77½
Idris Hydraulic	38¾	35½	35¾
Ipoh	42	49½	43½
Kamunting	97	71	63
Kent (F.M.S.)	59½	54	51
Kepong	24	25¾	18
Kinta	34½	30½	30
Kinta Kellas	32	23¾	25
Kramat Pulai	24½	25½	22½
Kuala Kampar	147	—	142
Lahat	21¾	21	19½
Malaya Consolidated	79	70½	66½
Malayan Tin	160¾	172¾	154¾
Meru	20¾	20	—
Pahang	209½	206	208
Pattani	5	3½	4¼
Pengkalen	65½	51	51
Petaling	178½	190	220
Rahman	59½	59½	56½
Rambutan	15	15	12
Rantau	52	69	55
Renong	60½	60¾	50¾
Selayang	25¾	18	12½
Southern Malayan	104½	104½	95½
Southern Perak	80½	50½	47
Sungei Besi	46	46	43
Sungei Kinta	29¾	38¾	33¾
Sungei Way	35¾	44½	47½
Taiping	35	41	41
Tanjong	41½	22½	24
Teja Malava	8	13½	6
Tekka	48	50½	50½
Tekka-Taiping	51	51	45
Temoh	—	17	15¾
Tronoh	108	96	109¼

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	December.	January.	February.
	Tons.	Tons.	Tons.
Amari	7	—	—
Anglo-Nigerian	65	60	—
Associated Tin Mines	274	245	—
Baba River	5½	5½	—
Batura Monguna	4½	4½	—
Bisichi	50	53	56
Daffo	6	6	5
Ex-Lands	65	50	—
Filani	2½	2	1½
Jantar	35	40	35
Jos	25½	19	17
Juga Valley	14	11	—
Junction	20	20	—
Kaduna	40½	41½	30½
Kaduna Prospectors	23¾	26½	18
Kassa	16	17	—
Lower Bisichi	6½	5½	4
Mongu	60	35	—
Naraguta	33	30	—
Naraguta Durumi	—	—	9
Naraguta Extended	26	10	10
Naraguta Karama	25	30½	—
Naraguta Korot	15	—	—
Nigerian Base Metals	44¼	62¾	—
Nigerian Consolidated	20	20	20
N.N. Bauchi	150	150	—
Offin River	9½	12½	12
Ribon Valley	17	18¼	—
Ropp	80	80	81
Rukuba	4	4	—
South Bukeru	6	10	12½
Tin Fields	6½	7	6¾
Tin Properties	22	24	—
United Tin Areas	6½	7½	—
Yarde Kerri	10	10	15

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	Dec.	Jan.	Feb.
	Tons.	Tons.	Tons.
Anglo-Burma (Burma)	19½	11	6
Aramayo Mines (Bolivia)	345	253	251
Bangrin (Siam)	33¾	44¾	41¼
Berenguela (Bolivia)	33	33	—
Briseis (Tasmania)	30	20	—
C'nsolidated Tin Mines (Burma)	107*	94*	—
Eastern Siam (Siam)	11	11	3½
East Pool (Cornwall)	80½	83	81
Fabulosa (Bolivia)	158	165	145
Geevor (Cornwall)	70	68	68
Jantar (Cornwall)	—	29‡	—
Kagera (Uganda)	23	23	23
Leeuwpoort (Transvaal)	180†	—	—
Levant (Cornwall)	117¾†	—	—
McCreedy (Swaziland)	15½†	—	—
Rooiberg (Transvaal)	115‡	—	—
San Finx (Spain)	40*	36¼*	—
Siamese Tin (Siam)	117½	120½	98
South Crofty (Cornwall)	75¾	66½	61¼
Tavoy Tin (Burma)	60	50	—
Theindaw (Burma)	6	5	—
Tongkah Harbour (Siam)	87	87	86
Toyo (Japan)	35	41	—
Wheal Kitty (Cornwall)	29	42	—

* Tin and Wolfram. † Three months. ‡ Two months.

STOCKS OF TIN.

Reported by A. Strauss & Co., Ltd., Long Tons.

	Feb. 28.
United Kingdom Stocks :	
Straits	830
Australian	67
Banka	110
Other Standard	7,486
Banka Straits and Australian Landing	275
United Kingdom Afloat :	
Straits	2,165
Australian	50
Banka	494
Continent :	
Banka in Holland	—
Do. Afloat	1,074
Straits do.	750
Other Countries :	
Straits and Banka Afloat	597
United States Straits and Standard :	
Afloat	8,566
Landing	2,537
Stock	770
Total	25,771

SHIPMENTS, SUPPLY, AND CONSUMPTION OF TIN.

Reported by A. Strauss and Co., Ltd., Long Tons.

	Feb.
Imports of Bolivian Tin into U.K.	2,796
Total Shipments of Bolivian Tin	600*
Imports of Nigerian Tin	762
Shipments of China Tin	280
Shipments of Straits Tin	7,766
Shipments of Banka Tin	1,410
Supply :	
Straits United Kingdom	1,935
,, Continent	735
,, United States	4,540
,, Other Countries	556
Banka	1,410
Australian	125
Standard U.K. and U.S.A.	3,122
Total	12,423
Consumption :	
United Kingdom deliveries	795
Dutch ,,	696
United States ,,	6,750
Continent ,,	1,013
Other Countries ,,	527
Total	9,781

* January.

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES.

In Tons.

	Dec.	Jan.	Feb.
Anglo-Ecuadorian	13,679	13,106	12,024
Anglo-Egyptian	25,442	19,560	—
Apex Trinidad	31,950	32,640	31,880
Attock	6,760	9,430	7,135
British Burmah	5,760	5,700	5,016
British Controlled	37,559	30,426	31,528
Dacia Romano	—	—	—
Kern Mex	1,436	1,044	860
Kern River (Cal.)	5,390	5,690	3,226
Kern Romana	4,296	3,906	3,572
Kern Trinidad	3,807	4,548	3,733
Lobitos	25,722	26,901	25,268
Mexican Eagle	100,714	78,001	—
Phœnix	29,236	33,484	32,516
St. Helen's Petroleum	5,654	5,218	11,214
Steaua Romana	64,430	60,670	50,390
Trinidad Leaseholds	35,150	34,200	28,800
United of Trinidad	4,883	5,872	—
Venezuela Oil Concessions	575,666	514,181	—

PETROLEUM PRODUCTS PRICES. London, March 7.

Refined Petroleum : Water white 8½d. per gallon ; standard white, 7⅞d. per gallon ; in barrels 3d. per gallon extra.
Motor Spirit : Inner London Zone : Aviation spirit 1s. 9d. per gallon ; No. 1, 1s. 5d. per gallon ; No. 3, 1s. 3d. per gallon.
Fuel Oil : Furnace fuel oil, £3 7s. 6d. ; Diesel oil, £4 per ton.
American Oils : Best Pennsylvania crude at wells, $4·10 per barrel. Refined standard white for export : in barrels 14·25 cents. Refined water white : in barrels 15·25 cents.

QUOTATIONS OF OIL COMPANIES SHARES.

Denomination of Shares £1 unless otherwise noted.

	Feb. 6, 1929			Mar. 7, 1929		
	£	s.	d.	£	s.	d.
Anglo-American	3	6	3	3	12	6
Anglo-Ecuadorian	1	3	9	1	2	0
Anglo-Egyptian B	2	13	9	2	15	0
Anglo-Persian 1st Pref.	1	8	0	1	7	0
,, ,, Ord.	4	6	3	4	8	9
Apex Trinidad (5s.)	1	6	3	1	6	3
Attock	3	0	0	3	0	0
British Burmah (8s.)		7	3		7	0
British Controlled ($5)		5	3		5	0
Burmah Oil	4	7	6	4	7	6
Kern River, Cal. (10s.)		8	0		8	6
Lobitos, Peru	2	2	6	2	1	3
Mexican Eagle, Ord. (4 pesos)		13	6		12	9
,, ,, 8% Pref. (4 pesos)		13	0		12	0
Phœnix, Roumania		14	0		13	0
Royal Dutch (1,000 fl.)	32	0	0	32	10	0
Shell Transport, Ord.	4	16	3	4	12	6
,, ,, 5% Pref. (£10)	9	17	6	9	18	9
Steaua Romana		12	0		11	3
Trinidad Leaseholds	4	6	3	4	6	3
United British of Trinidad (6s. 8d.)		8	9		9	6
V.O.C. Holding	4	8	9	4	2	6

DIVIDENDS DECLARED BY MINING COMPANIES.

During month ended March 9.

Figures in brackets represent par value of shares and the dates are the days on which the dividends are payable.

Amalgamated Zinc (8s.), 4%, April 10.
Anglo-American Corporation of S. Africa (£1), 2s. 6d. less tax, March 20.
Balaghat (10s. Pref.), 6d. less tax, April 3.
,, (10s. Ord.), 6d. less tax, April 3.
Consolidated Mines Selection (10s.), 2s. less tax.
Exploration (10s.), 1s. 3d. less tax.
Kagera Tinfields (5s.), 6d. less tax, March 5.
Koflyfontein Mines (£1), 3s. less tax.
Kramat Pulai (£1), 6d. less tax, March 11.
Malayan Tin Dredging (5s.), 6d. less tax, March 13.
Mysore Gold Mining (10s.), 1s. 6d. less tax, March 23.
North Broken Hill (£1), 2s. less tax, March 27.
Nundydroog (10s.), 1s. 6d. less tax, March 27.
Renong Tin Dredging (£1), 1s. 6d. less tax, March 4.
Rhodesian and General (£1), 3s. 6d. less tax, February 28.
South African Gold Trust (£1), 2s. less tax, March 26.
Southern Malayan Tin Dredging (5s.), 3d. less tax, March 12.
Southern Perak Dredging (£1), 1s. less tax, March 11.
St. John del Rey (£1 Pref.) 1s. free of tax.
,, ,, (£1 Ord.), 1s. 6d. less tax.
Tanganyika Diamonds (5s.), 1s. 3d. less tax.
Tehidy Minerals (£1), 3d., free of tax.
Tekka (£1), 4½d. less tax, March 2.
Venture Trust (10s.), 9d. less tax, March 12.
Witbank (£1), 6d. less tax, April 3.

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

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

	Feb. 6. 1929 £ s. d.	Mar. 7, 1929. £ s. d.
DIAMONDS:		
Consol. African Selection Trust (5s.)	1 10 0	1 7 0
Consolidated of S.W.A.	1 6 3	1 5 6
De Beers Deferred (£2 10s.)	12 12 6	14 1 3
Jagersfontein	2 11 3	2 14 6
Premier Preferred (5s.)	5 15 0	6 0 0
COPPER:		
Arizona Copper (5s.) Arizona	1 6 6	1 12 0
Bwana M'Kubwa (5s.) Rhodesia	1 2 3	1 0 3
Esperanza Copper, Spain	1 0 0	1 0 0
Messina (5s.), Transvaal	19 6	18 3
Mount Lyell, Tasmania	2 2 0	2 1 9
Namaqua (£2), Cape Province	1 2 6	1 2 6
N'Changa, Rhodesia	3 10 0	4 6 3
Rio Tinto (£5), Spain	65 7 6	62 0 0
Roan Antelope (5s.), Rhodesia	2 10 0	2 6 0
Tanganyika, Congo and Rhodesia	3 12 6	3 12 6
LEAD-ZINC:		
Broken Hill Proprietary N.S.W.	1 7 0	1 7 9
Broken Hill North, N.S.W.	5 1 3	5 1 3
Broken Hill South, N.S.W.	2 12 6	3 0 6
Burma Corporation (10 rupees)	18 0	17 0
Electrolytic Zinc Pref., Tasmania	1 15 0	1 15 0
Mount Isa, Queensland	2 2 6	2 1 0
Rhodesia Broken Hill (5s.)	5 6	4 0
Russo-Asiatic Consd. (2s. 6d.)	4 6	4 0
San Francisco (10s.), Mexico	1 15 0	1 15 0
Sulphide Corporation (15s.), N.S.W.	18 0	19 0
Tetiuhe (5s.), Siberia	4 0	5 0
Zinc Corporation (10s.), N.S.W.	2 5 0	2 9 0
TIN:		
Aramayo Mines (25 fr.), Bolivia	3 5 0	3 8 9
Associated Tin (5s.), Nigeria	13 6	12 0
Bangrin, Siam	2 0 0	2 0 0
Bisichi (10s.), Nigeria	11 0	10 3
Briseis, Tasmania	3 6	3 6
Chenderiang, Malay	11 0	11 0
Dolcoath (10s.), Cornwall	9	9
East Pool (5s.), Cornwall	2 0	1 9
Ex-Lands Nigeria (2s.), Nigeria	2 3	3 0
Fabulosa ($1.00), Bolivia	9	1 1
Geevor (10s.), Cornwall	9 0	9 0
Gopeng, Malaya	2 5 0	2 3 9
Idris (5s.), Malaya	16 9	16 0
Ipoh Dredging (16s.), Malay	1 8 9	1 8 9
Kamunting (5s.), Malay	17 6	16 9
Kinta, Malay	12 3	12 9
Lahat, Malay	14 0	14 3
Malayan Tin Dredging (5s.), Malay	1 9 6	1 8 0
Mongu (10s.), Nigeria	10 6	10 6
Naraguta, Nigeria	1 8 9	1 6 3
Nigerian Base Metals (5s.)	6 0	5 6
N.N. Bauchi, Nigeria (10s.)	1 3 3	1 2 6
Pahang Consolidated (5s.), Malay	11 0	11 6
Pengkalen (5s.), Malay	1 0 3	1 0 6
Petaling (2s. 4d.)	12 6	13 3
Renong Dredging, Malay	1 13 9	1 13 9
Ropp (4s.), Nigeria	9 3	8 6
Siamese Tin (5s.), Siam	19 6	18 0
South Crofty (5s.), Cornwall	5 3	5 6
Southern Malayan	14 0	14 6
Southern Perak, Malay	2 16 3	2 9 0
Southern Tronoh (5s.)	11 0	11 6
Sungei Besi (5s.), Malay	13 9	13 9
Tavoy (4s.), Burma	18 0	16 9
Tekka, Malay	1 0 0	19 9
Tekka Taiping, Malay	1 2 6	1 2 0
Toyo (10s.), Japan	10 0	11 6
Tronoh (5s.), Malay	1 0 0	1 0 6
FINANCE, ETC.:		
Anglo-American Corporation	2 5 0	2 6 0
Anglo-French Exploration	1 7 0	1 5 6
Anglo-Oriental (5s.)	12 6	19 3
British South Africa (15s.)	2 1 6	2 1 0
Central Mining (£8)	19 10 0	19 5 6
Chemical & Metallurgical Corp. (2s.)	4 6	4 0
Consolidated Gold Fields	3 2 6	2 18 9
Consolidated Mines Selection (10s.)	1 0 0	19 3
General Mining and Finance	1 7 6	1 3 0
Gold Fields Rhodesian (10s.)	12 0	11 4
Johannesburg Consolidated	2 10 6	2 8 9
London Tin Syndicate	3 17 6	4 0 0
Minerals Separation	4 5 0	5 3 6
National Mining (8s.)	4 9	4 3
Rand Mines (5s.)	3 8 9	3 4 6
Rhodesian Congo Border	4 12 6	5 15 0
Southern Rhodesia Base Metals	10 0	10 3
South-West Africa	16 0	16 0
Tin Selection Trust	1 12 0	1 6 3
Union Corporation (12s. 6d.)	4 15 0	4 10 0

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.

UMVUKWE CHROMITE DEPOSITS, RHODESIA

In Short Report No. 23 of the Southern Rhodesia Geological Survey, the Mining Geologist of the Survey describes the chromite deposits of Umvukwe Range in the Lomagundi District, Southern Rhodesia. Deposits are found in the northern section of the Great Duke and the area described by Mr. Keep (shown in the accompanying map) covers about 9 by 3 miles of the dyke, with about equal extents of county on each side of the dyke, as will be seen from the map.

The Great Dyke, which is an important geological feature of Southern Rhodesia, extends in a north-north-east to south-south-west direction for about 330 miles through Southern Rhodesia, its average width being about 4 miles. It consists of basic and ultra-basic igneous rocks which contain in different parts chromite seams, platinum ore, and asbestos. As will be seen from the map an irregular north and south line, defined by the boundaries between farms and following the summits of the range, which lie towards the eastern side of the Great Dyke, marks the boundary between the Mazoe district on the east and the Lomagundi district on the west. Nearly all the chromite occurs in the central part of the Dyke, and is found in the Lomagundi District. The Ethel asbestos mine, the treatment plant of which was described by Mr. Keep in the MAGAZINE for February, is found within the limits of the area mapped. The railways from Salisbury to Shamva (Mazoe district) and from Salisbury to Sinoia (Lomagundi district) pass within distances of approximately 30 miles from the Great Dyke in this area, being on its east and west sides respectively.

The eastern edge of the Great Dyke, at its contact with the granite, lies at an elevation above sea-level of nearly 5,000 ft., or 900 ft. above Concession station on the Shamva railway. The western edge of the Great Dyke has an altitude of approximately 4,500 ft., or 350 ft. above Banket station on the Sinoia railway. The Great Dyke in this area forms the Umvukwe Range, the peaks and ridges of which rise to elevations up to 1,000 feet above the floors of the transverse valleys penetrating the range.

The Great Dyke, within the limits of the area mapped, forms a belt of enstatite rock, partially or completely serpentinized as the case may be, trending from N. 22° E. to S. 22° W. It is in contact with granite, in places gneissic, upon both its eastern and western sides, and varies in width from two to three miles. The actual contact of the Great Dyke rocks with the granite is poorly shown, the two best exposures being at the points where the Msitwe and Jekeles spruits cross the road from the Ethel mine to the Matoroshanga pass. In both these exposures about 1 ft. width of red soil occurs between the granite and the Great Dyke roads. The latter consist of talc-schist for from 12 to 15 ft. inwards from the granite, followed by badly decomposed serpentine rock underlying the edge vleis of the Great Dyke. The talc-schist has a strike of foliation parallel with the edge of the Dyke and dips away from the granite at an angle of about 50°. In the north-east of the area outcrops of cemented breccia, the broken pieces of which are almost invariably serpentine rock, mark the eastern contact of the Great Dyke with the granite.

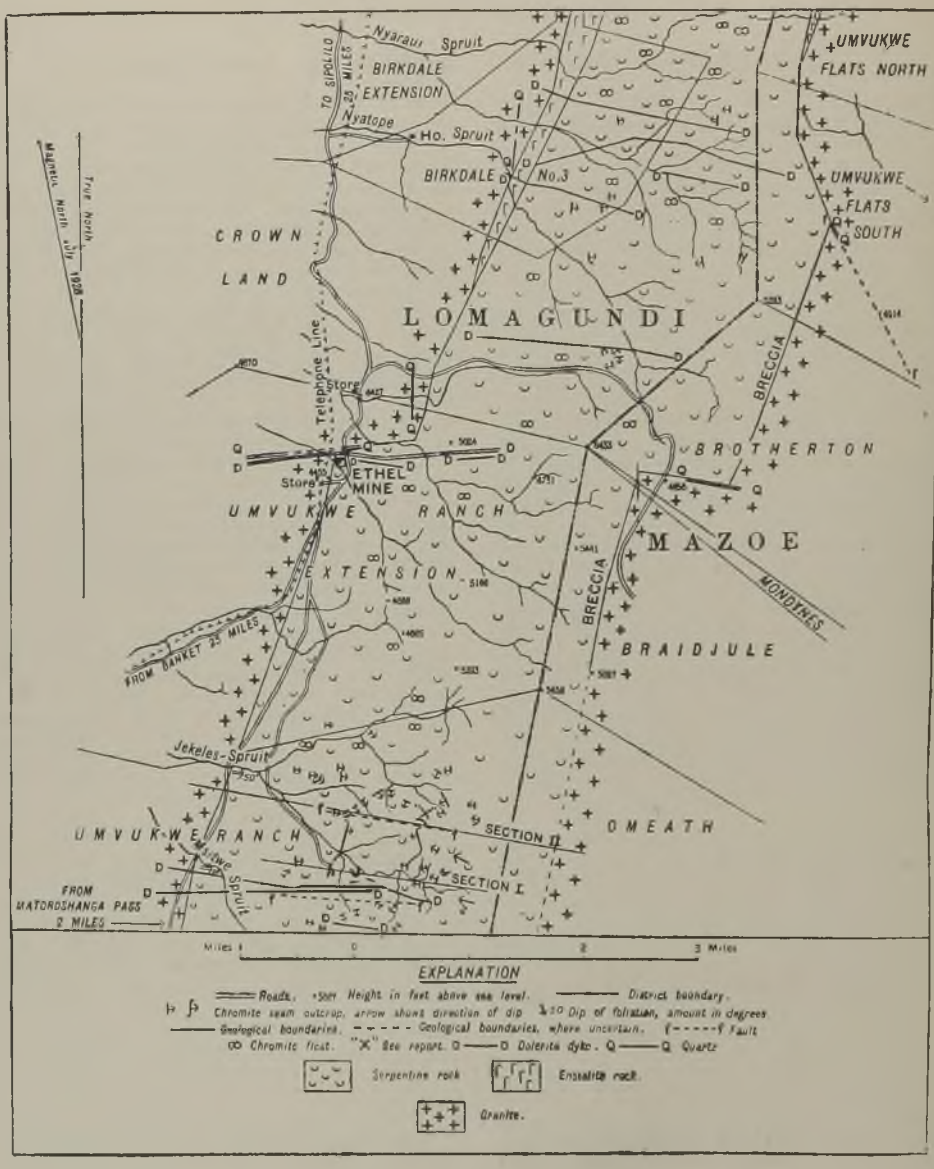
There is no doubt that differential movement has taken place between the rocks of the Great Dyke and the granite masses on either side. Whether this movement is due to faulting or to the expansion of the Great Dyke rocks upon serpentinization, which involves a large increase in volume, is as yet unknown.

A large number of transverse faults cross the Great Dyke from east to west, being marked by either (1) dolerite dykes, of which the largest passes through the Ethel mine, or (2) magnesite-opal veins. The dolerite dykes in many cases pass into the western granite in a manner which shows that no differential movement has taken place between the Great Dyke rocks and the granite after the intrusion of the dolerite. The magnesite-opal veins form the crests of many of the transverse ridges of the Great Dyke, and are often seen, where mining work has been done, to fault the chromite seams. They rarely possess a throw exceeding 6 ft. The faults are of varying inclinations, from almost flat, when they are often found forming the foot or hanging walls of chromite seams, to nearly vertical, in which case they cut through and fault the chromite seams.

Chromite ($FeO.Cr_2O_3$) is an oxide of iron and chromium (32 and 68% by weight respectively) crystallizing in the cubic system as octahedra, but often found having a fine-grained compact structure. It is iron-black and brownish-black in colour, and has a hardness of 5·5. It is a heavy mineral (specific gravity of 4·3–4·5), of which approximately 9 cu. ft. weigh one ton of 2,240 lb. In all calculations of tonnages found in the matter below it has been considered that it requires 9·5 cu. ft. of chrome ore to weigh one ton, the increased figure having been taken owing to the fact that the grade of the chrome ore never reaches the 68% of the pure oxide.

It is only upon those blocks of claims upon which the seams have been opened up that a true idea can be obtained of the character of the occurrences, and data collected upon which to base estimates as to the probable and possible tonnages available. The claims upon which most work, with the object of proving the extent of the chromite deposits has been done are those originally pegged by G. Peake, and now the property of the British Asbestos Chrome Co., of London. The surface indications over the whole area mapped are sufficiently

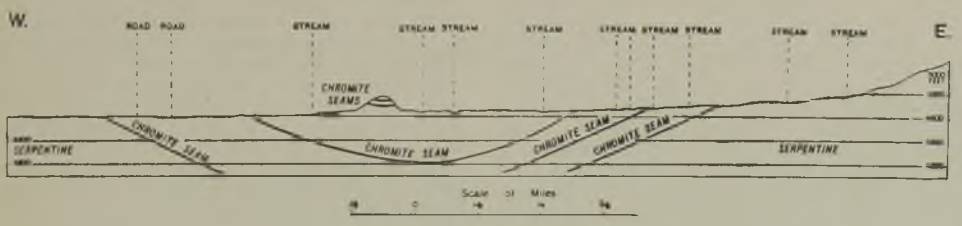
promising to justify the statement that the showings on the claims mentioned are probably no more than a fair index of what may be expected over the remainder of the area. Certain blocks of claims, however, particularly on the silicified serpentine in the north-east of the map, do not appear to be of much value. These latter represent but a small fraction of the blocks registered, and have been allowed for in the tonnage estimates to be found in the sequel.



The economically valuable chromite occurs in narrow seams in serpentinized enstatite rock. Although found with a mode of occurrence bearing a superficial resemblance to coal seams, they differ from the latter in that they occur in an igneous, not a sedimentary, rock and have an entirely different origin. The seams vary in thickness up to 30 in., with an average of about 7½ in. They have a general direction of strike parallel with the edges of the Great Dyke, any abnormality in this direction being commonly associated with faulting. As may be seen on reference to Sections I and II the chromite seams dip inwards from the edges of the Great Dyke, any seams outcropping in the centre being generally flat. The foot and hanging walls of the seams consist of both chromite-rich and chromite-poor serpentine rock, except in those cases in which the wall of a particular seam is the plane

of a fault, in which case a band of magnesite and opalescent silica, varying up to 6 in. in thickness, is found on that wall.

It has been noted, during the examination of over a hundred exposures of chromite, that no rule can be given as to the occurrence of a chromite-rich casing on either or both of the foot and hanging walls of any seam. In some cases from 2 in. to 4 in. of serpentine rock plentifully besprinkled with chromite crystals occurs on both walls of a seam, serpentinized enstatite rock. Owing to the affinity of like crystals for one another, the chromite crystals would tend to concentrate at certain horizons in the molten magma, such horizons owing their existence to the physical state of the magma at varying depths during cooling. The concentration of the chromite in any particular plane is probably due to circumstances analogous to those attendant on flotation in metallurgical practice. There can be little doubt, in fact, that

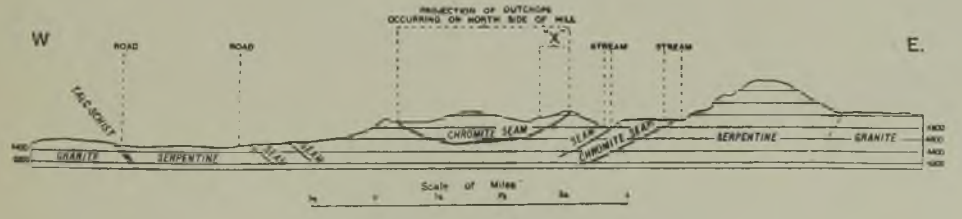


SECTION I.

this type of rock passing imperceptibly into serpentine rock showing no exceptional quantity of such crystals. Occasionally the chromite-rich serpentine rock is only seen on one wall, either foot or hanging, and in other cases it is entirely absent.

The importance of the above observations lies in the light they shed on the mode of origin of the chromite seams. It is obvious that the seams are not replacement deposits in the serpentine rock, as no pseudomorphs of chromite after serpentine can be seen. On the contrary, the chromite crystals within the serpentine rock are perfectly formed, showing that they crystallized when having space in which to form, such as in a molten magma. The occurrence of chromite-rich foot-wall casings shows that the first-formed the chromite seams were formed at successive horizons in the enstatite rock-magma during the cooling of the latter, the resulting deposits being sheet-like bodies, all the points on each of which were at an approximately equal distance below the surface of the intrusion, or extrusion. This mode of origin is known as magmatic segregation.

The variation in thickness of any particular chromite seam, when followed along its strike or down its dip, is possibly due to local eccentricities in the original amount of chromite in the overlying magma. It may, on the other hand, be due to differences in the rate of cooling of the magma at various points within that magma. At what period the enstatite rock became serpentinized is a point upon which further research is required before an opinion can be hazarded.



SECTION II.

chromite crystals did not gravitate through a molten mass until they came in contact with, and failed to penetrate, the upper surface of a cooled earlier intrusion. Such might be imagined to be the case if only the hanging-wall casings showed chromite-rich serpentine rock. It must be concluded that the seams were formed by the gradual sinking of the chromite crystals, which would naturally solidify, owing to the high melting point of chromite, before the bulk of the constituents of the rock-magma now represented by the

After the formation of the chromite seams, earth-movement, possibly as a result of the expansion of the rock during serpentinization, resulted in the formation, as may be seen in any section of the Great Dyke, of a synclinal trough, the axis of which is approximately the centre line of the Great Dyke. At the same time minor folding and faulting, the axes of the folds and strikes of the majority of the faults being at right angles to the axis of the main syncline, took place. The result of these latter processes can be well seen on

the map, where the chromite seam immediately north of Section Line No. II can be seen to dip southwards. These dips, however, are low as compared with the dips of the seam to the east and west, 9° as compared with 25° to 40°. Other anomalous dips, both in amount and direction, occur in the neighbourhood of the transverse, that is, east to west, faults.

From a study of the mode of origin of the chromite seams there can be no doubt that the outcrops seen to-day are those of seams which form synclinal beds in the Great Dyke, in other words, that the seams continue to depth in a manner as shown on the accompanying sections. If further proof be needed, it is only necessary to turn to Section I, where the bases, or lowermost points, of two such synclinal beds are seen outcropping in the small hill in the centre of the section. These represent the remains of two seams, the upper flanks of which have been denuded. A similar occurrence may be seen immediately south of the dolerite dyke on the Crown land, 2½ miles north-east from the Ethel mine, where the horseshoe-shaped outcrop shown on the plan is the outcrop of the remains of an upper seam near the summit of a hill, a lower seam being shown at a lower level to the south and east.

The uppermost chromite seam shown on Section II outcrops to the north, east and west of the line of the Section on the map. As shown in the figure the seam is projected from its northern outcrops, where it has an average dip to the south of 9°, on to the plane of the section. At the point where this plane may be seen to cut the seam ("X" on the map and Section II), the latter can be traced in the field for 600 ft. down its dip, the outcrops occurring in the side of a hill.

Further examples of extension to depth of chromite seams, as proved in the field, occur on dip slopes immediately north and south of the eastern end of Section Line No. I, where outcrops can be followed down the dip of the seam for distances of 1,000 and 750 ft. respectively.

It may be confidently affirmed that the chromite seams extend to depths far beyond that at which mining operations are economically possible at the present time, and that, if in any particular case a seam appears to cut out at depth, it will be found that the cause of such an apparent end is later faulting, not a result of the original manner of deposition of the chromite.

During the author's work in this area careful measurements of each seam as exposed in the outcrop workings were made. From the figures obtained the author has conservatively estimated that 200,000 tons of chromite are available for every 100 ft. in incline depth from each mile from north to south of the Great Dyke. In other words, taking the average width of the Great Dyke as 2¾ miles, an average of 200,000 tons can be obtained from every 2¾ square miles of Great Dyke rock, no mine working exceeding 100 ft. in incline depth. As the depth of 100 ft. is purely arbitrary, the tonnage to be produced is capable of great expansion if mining to a greater depth be economically justified.

That the above estimate is conservative is shown by a statement made by a chromite producer in the southern Umvukwes that he obtained 1,500 tons from each block of claims, no working exceeding 12 ft. in depth. This is equivalent to over 125,000 tons per square mile to a depth of 100 ft., or approximately 344,000 tons to 2¾ square miles to a depth of 100 ft. It must be borne in mind, however, that the latter tonnage is probably only obtainable from selected blocks, while the author's estimate is an average for a very large area.

The question of the economic value of the chromite deposits of the Umvukwes is bound up with two things:—(1) markets, (2) transport. If the chromite market be able to absorb large tonnages of the ore in addition to that already produced from elsewhere, the only requisite for the establishment of a large mining industry in this area is the provision of cheap transport. At the present time mining costs in those areas between the Umvukwes and Darwendale, in which chrome is being produced, are said to vary between 12s. and 14s. per ton of 2,240 lb., inclusive of loading the waggons or lorries for transport to the railway. The former figure is for shallow surface work, down to 12 ft. in depth, while a chromite seam 30 in. in thickness has been mined to an incline depth of 450 ft. at a cost of 14s. per ton. Transport costs vary from 7d. to 9d. per ton-mile, several large producers paying, at the present time, between 14s. and 17s. per ton for road transport by ox-waggon or motor-lorry between the mine and the railway. It naturally follows that the question of the economic depth to which mining can be carried out depends largely upon the distance between the mine and the nearest loading station on the railway, a decrease in road transport costs resulting in a huge tonnage of previously useless chromite becoming of economic value.

ESTIMATING PLATINUM METALS IN ORES

At the November meeting of the Chemical, Metallurgical, and Mining Society of South Africa, two papers were read on the determination of platinum metals in ores and concentrates by H. R. Adam and John Watson respectively. Mr. Watson's paper will be quoted in a subsequent issue, and herewith an account is given of Mr. Adam's paper. Mr. Adam's work has been done during the last three years at the laboratory of the Government Areas mine, where ores and concentrates from the Potgietersrust Platinum Co. have been regularly examined.

The paper is divided into two sections:—(I) The assaying of ore samples which includes also feed and residue samples from concentration plants; and (II) the examination of flotation and gravity concentrates of 100 dwt. per ton in value and upwards.

Section I. Four methods may be considered:—(*a*) The production of a sufficient quantity of precious metals for chemical analysis; (*b*) the more or less standard method of collecting the platinum metals in silver and parting with sulphuric acid, the result being reported in the convenient term "platinoids," this term including gold; (*c*) the estimation of the platinoids without in-quartation with silver and without parting; (*d*) the collection

of the platinoids in an accurately weighed quantity of pure gold. All these methods require a preliminary fusion and collection of the precious metals in lead, which is afterwards cupelled.

The author makes some general remarks on the question of fusion and cupellation. It is advisable to crush the final portion of the sample very finely, say to pass a 90 mesh sieve. The basic nature of the ore gangue demands a flux containing plenty of silica, and precautions are required if the sample contains an appreciable quantity of nickel and copper. The addition of red lead to the flux is the most convenient method of removing the latter into the slag. The temperature of both fusion and cupellation furnaces should be somewhat higher than is customary in gold assaying.

It has been said that platinum metals may be to some extent oxidized, or at least dissolved in some form in the slags, and that once in this condition they are not recovered by a subsequent assay of the slag. This has been examined by the following methods :—(1) Assaying slags with suitable flux ; (2) assaying slags without the addition of litharge, so as to reduce the lead remaining in the slag ; (3) assaying synthetic samples containing known quantities of platinum and palladium, incorporated in barren gangue. The conclusion arrived at from these tests was that when good fusions are obtained no serious errors are caused by losses in slags. Further, where poor fusions have occurred, or when very rich samples are being assayed, platinum metals can always be recovered by a subsequent assay of the slag.

With regard to cupellation little need be said at this stage beyond noting the advisability of a high finishing temperature, and no overloading of the cupels with lead.

Method (*a*) ; chemical analysis of the precious metals obtained by fusion and cupellation. While this would no doubt be the most strictly scientific method of assaying platinum ores, the author has considered it as quite impracticable to carry out on individual samples, when hundred of assays are required, as in the development and prospecting of properties. On the few occasions when it has been necessary to report the constituent metals in individual samples he has simply adopted the somewhat cumbersome plan of making a large number of fusions, so as to collect a sufficient quantity of the precious metals for analysis according to the methods indicated in Section II.

Although the author has no definite information on the precedure employed, it is evident that when special samples are sent overseas for checking purposes a fairly complete analysis is made, comprising platinum, palladium, gold, and other metals of the platinum group. Figures for these constituents are given on samples of 10 dwt. and less, per ton of platinoids. Thus if one kilogram of sample is supplied and the whole is fused, about 17 milligrams of the precious metals will be available for analysis. It is quite possible to make determinations on quantities even less than this. Fortunately, however, he was in a position to adopt the plan of estimating the relative proportions of the different platinum metals in particular zones of a mine, by periodic examination of collected prills from numerous assays and had therefore not done much investigation on possible methods of making complete analyses on individual samples of a total content of a few dwt. per ton.

Method (*b*) ; the sulphuric acid parting method. Were it not for the presence of palladium in most of the Transvaal ores this would undoubtedly be the most satisfactory method when large numbers of assays have to be carried out, as considerable latitude in the details of parting would be permissible without great variation in the results. When platinum assaying first became important in the Transvaal the parting was done more or less according to the text-books with the acid brought to fairly strong fuming, no very definite attention being paid to the finishing point. The effect was the solution of varying proportions of the palladium with consequent discrepancy in the results. This was drawn attention to by K. L. Graham (*S.A. Mining and Eng. Journal*, March 19, 1927). Briefly, the recommendations given in this paper were, that in order to prevent the loss of palladium the parting should be carried out at a temperature high enough to dissolve the silver, but with the precaution that the parting vessel should be removed from the source of heat as soon as the silver was dissolved, as indicated by the last appearance of gas bubbles.

Generally speaking, the author's experience of this method, which he calls the " modified parting method," is that the proportions of retained impurities (lead and silver) vary very considerably according to the interpretation of the finishing point, the ratio of silver and the relative freedom of the silver-platinoid bead from lead after cupellation, and that consequently no constant correction factor can be applied.

It would be desirable in judging of the reliability of the modified parting method to have some analyses of the parted prills in which the impurities were directly determined. Usually when prills are analysed it is for the purpose of finding the proportions of precious metals, and the impurities are reckoned by difference. It has been found to be rather a difficult matter to make accurate estimations of lead and silver in the small quantities of prills usually available, especially when an analysis of the precious metals is also required.

There is some evidence that the retention of lead is relatively greater in the assays of samples of high value ; perhaps if it were possible to have a definite ratio of silver in each assay and to reinquart and part a second time in all the samples of higher value greater accuracy would be obtainable.

Apart from the direct examination of parted prills there is considerable indirect evidence that the modified parting method may frequently give unduly high results. Thus, during December, 1926, and January and February, 1927, several hundred assays of Rustenberg ore were being made and the prills and parting acid from every batch of 50 to 60 samples were examined. The following figures represent the ratio of palladium left in the prills to palladium in the parting acid :—Weight of prills analysed, 200 milligrams ; palladium found in prills, 43 milligrams ; palladium found in acid, 6 milligrams. That is only 12% of the total palladium was dissolved or 3% of the prills. These assays were done before the introduction of the modified parting method, and although the acid treatment was not specially drastic it was on the whole considerably more severe than is customary in modified parting.

When discrepancies have occurred in check assays in which one or other of the laboratories

have used the modified parting it has seldom been possible to explain the differences satisfactorily, on the basis of dissolved palladium. As against this drawback the modified parting method has been found to give reasonably consistent figures, at least on Rustenberg ores where the platinum-palladium ratio is in the neighbourhood of 3 to 1. It also establishes something in the way of a definite end-point, although unfortunately not sufficiently definite to altogether overcome the personal factor in parting.

Finally the results reported on samples sent overseas for checking have been on the whole fairly close to or even higher than those obtained by this method.

Method (*c*); the non-parting method. In the Potgietersrust district the platinum-palladium ratio is approximately 1 : 1 and the parting difficulties in platinoid estimations are correspondingly increased. For this reason Mr. O'Neill, the chief assayer at Potgietersrust, adopted the plan of reporting total platinoids by simply weighing the cupelled bead without in-quartation with silver and using as high finishing temperature as possible in cupellation with an ordinary coal-fired muffle. At the same time he obtained a platinum figure by parting with strongly fuming acid. The prills from this process are periodically analysed at the Government Areas laboratory and the appropriate corrections applied. This procedure, though somewhat complicated has been found to work reasonably well in practice. It also led to a closer examination of the non-parting method for total platinoids as a possible alternative to the parting method. The process simply consists in transferring the beads from the cupel as received fro n the ordinary muffle to special cupels for heating in a high temperature furnace. It is found that by heating at about 1,300° C. for an hour the lead content is reduced to 10% or less. By grinding a No. 9 cupel flat and drilling small holes in the smooth face, 30 or 40 small beads can be heated in one cupel and the furnace at present in use at the laboratory can easily take four of these. Mr. B. O. Pausey, electrical engineer to the Government Areas, designed and built for the laboratory a high temperature furnace which is proving very suitable. In this furnace, which is built of stock-sized fire bricks and heated by carborundum rods, arrangements are provided for supplying a small current of hot air over the cupels. The main difficulty which was experienced—namely, the making of electrical connections to the carborundum resistors which would last for a reasonable period—has been successfully overcome.

The following criticisms of this method may be anticipated :—

(1) Are losses in slags greater when no silver is added ? A drastic test was made on this point recently on a rich sample of over 3,000 dwt per ton in value, with the result stated below :—(i) Slag from non-silvered assay, 18 5 dwt per ton ; (ii) slag from silvered assay, 19 0 dwt per ton. In both cases the slags were assayed by the parting method. Slags from the non-parting method have been frequently assayed and no greater losses are found than is the case with silvered assays.

(2) Are there greater losses by absorption in cupels ? The answer to this is, that there is a slightly greater danger of loss, but that normally no serious error is caused. The results of one or two of the tests that have been made are as follows :—(i) Cupels from the asssay of the above mention rich sample (over 3,000 dwt. per ton) platinoid found, equivalent to 10 dwt. per ton or 0·3%. (The cupels from the corresponding silvered assay were examined and reported to contain no weighable amount of platinoid.) (ii) flotation concentrate, value 130 dwt. per ton, no weighable amount of platinoids found in the cupels ; (iii) flotation concentrate, value 120 dwt. per ton, no weighable amount of platinoids found. Examples (ii) and (iii) were concentrates containing several per cent of nickel and copper. The cupel assays were in every case in-quarted with silver and parted as usual.

Occasionally, however, cupels have shown appreciable absorption of precious metals, and this has been noted with silvered beads as well as non-silvered beads. This can generally be attributed to the overloading of the cupel with lead or to a low finishing temperature in the muffle. In the case of the non-silvered beads these points are of great importance.

As an example of the loss that may be expected under unfavourable conditions, that is too low muffle temperature and irregular cupellation, the following may be cited. The central portions of the cupels from fusions representing 60 samples (120 A.T.) were assayed by in-quartation with silver and parting ; the platinoid found was equivalent to 0·17 dwt. per ton. The average value of the samples was approximately 9 dwt. per ton, so that a loss of nearly 2% is indicated in this case.

(3) Is there any loss by volatilization ? This point has not yet received very close investigation, although it is hardly to be expected that this could cause serious error. It is found that it is the palladium that holds the lead most tenaciously even after the high-temperature treatment. Analyses of concentrate prills practically always show a small proportion of retained lead when the proportion of palladium is low.

(4) Silver, if present to any extent, would no doubt cause an error, but only in gravity concentrates from Potgeitersrust has silver been detected and that only in small amounts. Flux, of course, must be free from silver.

In addition to its application in routine assaying, this method is very useful when assaying the products from extraction tests. Thus, by cupelling the assays from feed, concentrate, and residue samples at the same time and giving all the prills the same time in the high-temperature furnace, correct relative values can be quickly arrived at. Investigations on the method are being continued so as to determine more definitely questions regarding the most suitable time and temperature required. In the meantime it may be regarded as a feasible alternative to the parting method. As in all platinum assaying it is, however, advisable to periodically examine slags and cupels to analyse the prills.

Method (*d*) ; the gold method. This method is tedious and impracticable when many assays have to be carried out. It is occasionally useful in check work, but requires special precautions after cupellation in an ordinary muffle. It consists in adding an accurately weighed quantity of pure gold, about 20 times the weight of the platinoids, to the assay, and taking the difference in weight as platinoids. Blanks on barren gangue with gold alone are always necessary, and the beads after cupellation require treatment with the blow pipe to remove traces

of lead. The use of gold for collecting small quantities of palladium has been used with some success.

Section II; analysis of concentrates. When the pilot concentration plant at Potgietersrust commenced operations, the author was faced with the necessity for making analyses of samples of flotation and gravity concentrates in considerable numbers and in very limited time. Since then investigations have been continually carried on in the effort to increase the accuracy of the methods employed and at the same time to decrease the time required. In addition to concentrate analyses determinations of the precious metals in prills from mine assays are regularly carried out. The author does not discuss the many investigations that have been made. The final test of the methods will come when production of the metals is accomplished. It is also hoped that a more complete account of the work will be available at a later date.

Until recently the precious metals were collected in silver and the resulting beads collected together in sufficient quantity for analyses. He has now abandoned this and collects the precious metals without silver, removing traces of nickel and copper, when necessary, by a second cupellation and removing the bulk of the lead in the high temperature furnace.

In concentrates of 100 to 200 dwt. per ton content of precious metals, 6 or 8 A.T. are fused and cupelled. Flotation concentrates which contain several per cent. of nickel and copper, require special care in fluxing, and, when the greatest accuracy is aimed at, slags and cupels are again fused with suitable flux. As a rule, however, it is sufficient to wash the fusions with litharge. A rather large button of lead (over 50 grams per A.T. of concentrates) is obtained.

In the case of flotation concentrates, previous roasting and also preliminary acid treatment to remove the base metals have been tried but no advantage is obtained and the latter method is extremely tedious.

The final prills from the electric furnace are cleaned in acetic acid, weighed, and combined together to give a sufficient weight for analysis.

The prills are dissolved in dilute aqua regia and the usual evaporation with hydrochloric acid is carried out for the removal of the nitric acid. The solution is then diluted with a little water and allowed to stand for an hour or two, when the remaining lead, along with the insoluble platinum group metals, settles out. Traces of silver are observed occasionally in gravity concentrates. This is probably associated with the gold which these concentrates contain.

The solution of about 20cc. in volume is filtered through a special filter, which allows of a very small amount of wash liquid being used; alcohol is preferable in order to prevent the re-solution of the lead chloride.

The insoluble residue is ignited and cupelled, the small prill obtained being afterwards heated in the electric furnace to about 1,300° C. It contains, in addition to other metals of the platimum group, traces of platinum, palladium, and lead, but as its proportion to the total is very small this is not at present a matter of extreme importance.

The platinum in the filtrate is precipitated with ammonium chloride, the mixture preferably being allowed to stand over night, although no serious error is caused by filtering after an hour or so.

Traces of palladium in the platinum precipitate are easily detected by the slight orange colour produced. The ammonium platinic chloride is filtered off, washed with saturated ammonium chloride solution, and re-dissolved in hot water, the platinum being re-precipitated with formic acid as recommended by Krauss and Deneke.

No great differences in results are found by igniting the ammonium platinic chloride direct as compared with the formic acid precipitate, but much greater care is required in the ignition of the former; also, by dissolving on the paper, as indicated, insoluble impurities in the ammonium chloride are removed. If the amount of platinum is very small it is probably more accurate to in-quart the residue with silver and part strongly with sulphuric acid.

The filtrate from the platinum may be dealt with in a variety of ways. Formic acid precipitation, after neutralizing the solution, is rapid and has the advantage of including traces of other platinum group metals. On the other hand it has a distinct tendency to bring down any lead which is in solution. Dimethylglyoxime is free from the latter objection and also brings down the gold. Nitroso-B-naphthol is very effective; the merest traces of palladium can be detected by this reagent. It forms, however, a very bulky precipitate with larger quantities of palladium, which is difficult to wash thoroughly. Whichever method is used the precipitate is ignited after washing with hot dilute acetic acid, the ignited residue being called "palladium+gold." This is in-quarted with silver and parted with nitric acid to obtain the gold. Two in-quartations and partings are required to remove all the palladium. Alternatively, the gold may be removed before the palladium by precipitation with ammonium oxalate and oxalic acid. The gold obtained by this method always contains palladium, so that in-quartation and parting with nitric acid or removal of the palladium by other suitable means is required here also. The foregoing scheme is fairly rapid and duplicate analyses as a rule agree very well. For the most accurate results, however, it is advisable to re-dissolve and re-precipitate the platinum and palladium.

The author gives assays of three samples of concentrate as follows:

	Dwt. per ton.		
Platinum	263	61	69·8
Palladium	41	105	28·4
Gold	16	6	2·8
Other metals of Platinum group	2	8	2·8
Total	322	180	103·8

The figures in the analyses for "other platinum group metals" indicates the material remaining undissolved in aqua regia after removal of lead and silver. The amounts found are generally so small that so far no very serious attempts have been made to determine what metals are actually present. The fact that they are appreciably present in flotation concentrates and can hardly be detected in gravity concentrates from Potgeitersrust suggests that they may consist of rhodium and ruthenium rather than osmiridium. If the filtrate from the "palladium+gold" in the foregoing analytical scheme is reduced with zinc dust and lead acetate and the lead cupelled, traces of platinum metals are occasionally found which may possibly consist of these metals.

GEOLOGY FROM THE AIR

In a recent address to the South-Eastern Union of Scientific Societies, H. B. Milner discussed the application of the aeroplane to geological reconnaissance. His opinions and conclusions are based largely on experience gained in the course of three aerial journeys in the Middle East. These journeys included one in Iraq from the Persian Gulf across the plains of the Tigris and Euphrates to Baghdad, another from Cairo across Sinai, Palestine, Transjordania, the Syrian desert and Iraq plains to Baghdad, and the third, a return by much the same route from Baghdad to Cairo, in all a total flying distance of some 2,000 miles. These routes traverse strikingly different types of country, both physiographically and geologically. In the former connection, coast-line topography, coastal plains, undulating lowlands, mountainous tracts, rift-valleys, broad river valleys and expansive alluvial plains, vast stretches of desert with characteristic arid features are all displayed. Geology ranges from recent desert and alluvial deposits, Tertiary and Cretaceous sandstones, limestones, etc., to basaltic lavas and other rock-types of different ages and developments. Thus the scope of observation was sufficiently wide to enable the author to formulate certain definite conclusions as to the possibilities and limitations of this method of geological survey.

To the trained geologist, accustomed to read his science into the land-forms he is constantly studying, topography automatically attracts attention in the course of normal field-reconnaissance. But frequently limitations imposed by natural circumstances preclude examination of wide areas; even the panorama displayed from the highest peak has certain obvious defects, for instance obscurement of intervening valleys in mountainous regions and consequent loss of real sense of relief in middle distance. Looking down, where one is perhaps more accustomed to look up or ahead, compels a new viewpoint of the earth's surface and a corresponding readjustment of physiographical hence geological ideas. Regarded from surface-level both elevation and depression, if markedly contrasted, tend to convey to the mind an exaggerated impression, largely because observations are more or less circumscribed. Aerial observation, on the other hand, because of its far greater scope, and wider field, corrects such impressions, compels a truer perspective, and broadens the mind to think "regionally," that is, on a scale such as is quite impossible merely from ground-level. Aerial observations give vivid expression to the varied pictures of regional tectonics portrayed in the mind when reading appropriate works, where maps and diagrams have perforce to suffice in illustration of their teaching. But equally under different conditions the detail of smaller and more local structure may be assimilated; the aeroplane is not simply an instrument of regional study.

In the case of features of some magnitude, such as the Dead Sea and Jordan rift-valley, nothing short of the view from overhead is capable of animating that familiar black-line diagram of the text-book, designed to exemplify trough faulting, and of lifting it from a mere geometrical impression to a grasp of the real achievement; this feature, once observed on a large scale, as it can only be from the air, leaves a totally different but far more compelling impression of what really constitutes a rift-valley, incidentally of its geological complexity rather than simplicity, which is what the usual drawing tends to convey.

Certain factors have necessarily to be considered at the outset of any plan to apply aerial service to particular geological problems. Apart from the type of machine desirable for a specific survey, whether aeroplane or seaplane, its design, power, capacity for long distance and high altitude flight, facilities for photograph work and technical observation, the nature of the country to be explored from the air is of paramount importance. Obviously conditions vary according to latitude and climate, the latter influence affording some measure of the type and density of vegetation which may conceal the rocks from view.

Under tropical or subtropical conditions, in arid or semi-arid regions of distinct relief, observations are facilitated by the general sparseness or entire absence of vegetation, as in desert regions; in these circumstances geology stands out clearly; low altitude flying, say between 200 to 1,500 ft., enables detail of rock development to be observed, while at higher altitudes the wider rock-plan, particularly regarding such features as dip-slopes, escarpments, naked folds, fault-scarps or other prominent structures, may be clearly revealed both to the eye and the camera.

In the extreme case of desert conditions, implying a flat surface and few outcrops, little more is ascertainable from the air than can be gauged on the ground, unless some limit is sought to the monotonous expanse usually characteristic of these conditions; where loose sand is involved, however, the development, size, trend, and form of the sand-dunes observed over a fairly wide area are especially instructive, and the aeroplane affords technically the best and physically the most comfortable means of surveying them. Where the desert is composed of consolidated rock or pebble- and boulder-strewn ground, gentle undulation is more frequently observed, though its geological significance may be largely masked by the loose materials.

Under similar climatic conditions mountains and valleys may present the most striking geological features, especially where limestones or various coloured sandstones are evolved, though where dense forest or thick vegetation clothes the slopes or completely masks the valleys, aerial reconnaisance may cease to have any geological bearing at all, beyond that which may be read into observation of rivers and their tributaries. But even though in such circumstances the actual rocks may be entirely concealed, there is some compensation in the fact that the physical features are nearly always susceptible of geological interpretation and in opening up virgin territory, such knowledge gained from co-ordinated aerial traverses is of the greatest possible value. It really amounts to an estimation of prevalent strike of the rocks, judged either from common trend over long distances, from the recognition of dip-slopes or from obvious escarpments; coupled with observation of river-courses and their relationship to one or more physical features such as those mentioned, it is seldom that the data fail to provide the basic elements of geological survey.

As an example of an arid mountain region, the author cites the mountains flanking the Dead Sea in Palestine, which he had two opportunities of observing and photographing from the air, one from

a comparatively low elevation (300 to 400 ft.), the other from over 2,000 ft. above summit-line. The limestones and sandstones, their stratification, jointing, mode of weathering, dip-slopes, erosion scarps, local folding, faulting, were clearly discernible, and left no room for doubt as to the type of rocks involved and their structure, also their influence on the evolution of the topography (such as "wadis") displayed. Viewed from the higher level, instead of a series of disconnected impressions of the geology along the line of traverse, he was able to take in a vast stretch of territory wherein the mutual relationship of the contrasted features was revealed just as if one were looking down at a huge relief model.

Under temperate conditions, in higher latitudes, and in countries such as Britain, practically everything depends on relief and the nature of the rocks involved, particularly the plant ecology of the district, as to whether aerial survey for geological purposes is worth while. It does not follow that areas of comparatively gentle relief and prolific vegetation are necessarily difficult to interpret geologically; on the contrary, many observers are agreed that the Weald basin, for instance, is more clearly defined from the air than from any vantage-point on land. The Chalk scarps, northern Greensand ridge, rugged and much dissected Hastings Sand interior, especially the Crowborough Forest area, are well individualized when flying fairly low (about 300 to 400 ft.), while the coast sections on both sides of the Channel are nowhere better viewed than from the air.

Curiously enough, areas of more decided relief than the Weald, though only moderately clothed in vegetation, often present considerable difficulty in their fundamental geological interpretation. For instance, much of the Devon-Somerset country, the northern fringe of Exmoor, the Wye Valley and proximate parts of the Welsh borderland, are difficult to analyse, though the famous meanders of that river are always beautifully defined. Much, of course, depends on the nature of the rocks, on the structure of the region and on the density of the wooded tracts, also on the fertility of the soil: aerial survey serves to emphasize the fundamental relationship existent between these features, especially in connection with geology and soil, though it provides a rapid and accurate means of ascertaining which is the predominating influence.

In mountainous regions in temperate latitudes, altitude and complexity of relief are the dominating factors. Here again it is clear that much of the lowland and valleys reveal little of geological interest save for their form and the course of the rivers which they bear. But once clear of the vegetation line, the geology, often the structures, are strikingly displayed. Where not concealed by snow or ice, many of the ordinarily inaccessible peaks, ridges, and precipitous mountain sides are rendered plain in geologic detail; also, the disposition of the great ice-sheets and glaciers, often impossible to envisage as complete features from any one view-point, is readily grasped from above, with the added advantage that they can be studied as part of the complicated relief of a wide area, and not simply as separate entities.

Turning next to a consideration of coastal geology from the air, more particularly the facilities for studying precipitous and inaccessible cliff-sections which abound in this country, as elsewhere, there is no better method of analysing the geomorphology of a coast-line, of grasping its mode of development and essential geology over great linear distance, than from the air. A boat provides a means of viewing the land-margin panorama from sea-level, but it has obvious disadvantages compared with the aeroplane for the same purpose. It would be easy to give many examples of coast-line features that would demonstrate the facility with which bedding, jointing, dip, folding, faulting, colour-banding, current-bedding, cleavage, marine erosion, raised beaches, and so on, may be noted, while igneous rocks, their structures, modes of occurrence, and weathering (responsible as they are for some of the grandest and most inaccessible cliff-scenery), are similarly rendered susceptible of observation and photographic record.

In other territories where pioneer geological surveys are undertaken, coast-sections, if available, often provide the key to much that may be hidden inland, and naturally become the first points of attack. But difficulties frequently arise in the course of investigations in the wild, uncivilized regions. For instance, the cliffs may be very high, precipitous and inaccessible without elaborate rock-climbing gear; there may be a narrow ledge of foreshore or perhaps none at all, only a sheer descent into deep water; the state of the tide or continued swell of the sea may be such that at all times of the year no boat can possibly get within reasonable distance of the section.

Opportunities are afforded by aerial survey for charting and photographing, for the purposes of geological data, outlying islands to the coast, shoals and banks either submerged or just uncovered at low tide; shallow water lagoon features, even the sea-floor itself in clear waters, are often only discernible from the air, though admittedly in the two latter examples the actual amount of geological evidence available is likely to be very small. It is more a question of tracing submarine continuity of rocks and physical features relative to known cliff-sections, than of seeking new data, for in any case sea-life of every description tends to conceal solid geology. Incidentally, coral-reefs, especially those just submerged at all states of the tide, have been surveyed with success from the air. It is, of course, a well-known fact that submerged bodies, such as rock-shoals, sand-banks, etc., are revealed to aerial observation and to the camera, where nothing is visible from a boat or from water-level.

Closely allied to aerial reconnaissance of coastal features is the study of river-estuaries, submarine river-flow, river-channels, meanders, drift of sediment, influence of currents on detritus, deltas, delta-drainage, coastal swamps, marshes, lakes, etc. While it may be argued that such physiographical features are primarily the concern of the geographer, they fall equally within the province of the geologist, whose work, after all, is essentially that of explaining evolution of modern geography.

So far the types of landscape which, depending on climatic conditions, lend themselves best to geological analysis from the air have only been considered, and the author proceeds to other technical factors involved in this special reconnaissance. In the matter of altitude, there is both an upper and lower limit beyond which observations are difficult or impressions confused. Flying too low is disadvantageous, because, in other than coast sections, correct perspective is destroyed in the tendency to centralize detail, particularly on account of the relative speed of the machine which becomes increasingly obviously nearer the surface of the ground. In the case of coast observations, the dis-

advantage of flying very low is not quite so apparent, since the contrast of colour, flatness of the sea, and the sharp land-margin (especially where the cliffs attain some height and are made up of bold features) unite to mitigate the above tendencies to a great extent. Flying too high has the well-known effect of smoothing out irregularities in land-form ; the gentle undulations are completely lost ; even prominent peaks or hill-crests lose distinction, and what is in reality a highly serrated ridge, may appear almost a plateau unless viewed at a low oblique angle from some distance away. It is, of course, possible to attain such an elevation, actually about 12,000 ft. and over, where practically any type of topography will appear flat to the eye and all sense of relief is lost ; and what applies to topography obviously applies doubly to related geology. Where wide areas and regional features are required, observation from 1,000 to 4,000 ft., even more, may not be too much. The author's own experience is that flying at nearly 6,000 ft. on one part of the traverse of the mountains in Palestine rendered anything more than a bird's eye view of the main features impossible, although the visibility was excellent. Relatively high altitude flying over actually flat country, as portions of the Syrian desert, conveyed the paradoxical impression of ground undulation, especially in strong sunlight ; this was undoubtedly due to atmospheric conditions, possibly a kind of mirage effect.

Another important point in aerial observation is that of keeping to a definite course. It is extraordinarily easy to lose one's way in the air ; land-features present different aspects according to altitude, visibility, and angle from which they are viewed. Any tendency to zigzag across the strike of a prominent feature, or to deviate from some set course on which one's calculations are initially made renders it a matter of no little difficulty to keep consecutive ideas of the geological features under survey. Naturally, keeping a good course is the task of the pilot, and much depends on weather conditions, especially wind-velocity, cloudbanks, etc. The geologist should certainly ascertain beforehand approximately the direction intended over definite periods of flying, and should himself carry a compass to check his observations in this respect.

Again, geological, as topographical observations depend for accuracy largely on flying level, that is, keeping the machine level and avoiding tilt ; distortion of features, especially at low elevations, when the machine lists first to one side, then to another, or when banking, is very marked. Nowadays the modern aeroplane, particularly the high-powered, passenger-carrying machine, is fitted with elaborate instruments which record, by means of ingenious coloured lights, the angles of deviation from horizontal which it may make in course of flight.

During the last few years a number of concessions for petroleum have been taken up by different interests in countries such as Venezuela and Columbia, which properties naturally vary in size, position (with reference to towns or principal communications), density of vegetation (bush or desert), lines of drainage, accessibility, etc. It may be taken for granted that, in nine cases out of ten, no adequate maps of the areas initially exist, or in the tenth case the inaccuracy is such that of all intents and purposes it is valueless. Consequently some basic survey of the ground is necessary at the outset. Sometimes geologists have perforce to be their own surveyors ; in other cases specially trained surveyors are employed in addition to the geological staff. At all events, the first phase of exploration must necessarily be to establish directions of drainage, conspicuous topographic features or positions of other outstanding landmarks, to form the basis of communications, transport, and ultimately of geographical reconnaissance. A concession of any size, say, 5,000 square miles, will require considerable time for even a rough idea of the map to be attained, especially if the country involved is thickly forested, possibly virgin jungle. Not only will the time factor be important, but also considerations of personnel, transport, native labour, supplies, health, and all the paraphernalia of camp life, to say nothing of finance, will arise. In short, this sort of pioneer work implies nothing less than a fully equipped expedition, depending for its success on the organization and backing which those responsible for its initiation are able to effect. In such cases as this, the advantages of preliminary aerial survey, both for topographical and geological purposes, become obvious. In the former connection, either the whole or just a part of the concession may be photographed, from which the first map is produced by now standardized processes. It goes almost without question that the geologist will accompany the surveyor on these initial traverses, both in his capacity as advisor on geological matters, and also to exercise his discretion as to what parts of the concession appear favourable from surface features, and therefore require mapping in detail or what parts should be left for future consideration as the field is developed. The geological data accumulated from this initial survey are invaluable and, as with topographical evidence, are obtained in a fraction of the time, and with minimum effort, direct and indirect, which would have been occupied had the country had to be traversed on foot.

In point of fact, the geologist gains those vital first impressions of a new country quickly and with comparative ease. He notes his chief river courses and their tributaries, the latter, especially in more or less flat regions, destined to act as traverse-routes and furnish him with critical geological information. At the same time he is enabled to judge the best means of access, to form an opinion as to how far the main stream and tributaries are navigable by small river-craft such as motor boat or canoes, and to fix positions of base and subsequent camps. In undulating country he observes certain prominent features which will serve as geological objectives to which his traverses will be biassed. In short, he provides himself with all the data of a plan of campaign based on systematic observation, and thus saves himself and his employers days, possibly months, of more or less haphazard travel through difficult country.

Most tropical regions have their particular periods of rain, the wet season, when normal field-work becomes almost, if not entirely, out of the question. To some extent the aeroplane is independent of these conditions, and reconnaissance is possible at least during temporary breaks in bad weather, whereby the optimum period of field-survey is prolonged. It is appropriate to mention that under conditions where either during the wet or dry season, vast stretches of water prevail or where the main river is sufficiently wide and void of rocks, reefs, rapids, etc., hydroplane surveys have been attempted with considerable success.

Among the various districts in different countries which have repaid, and are still reaping benefit from aerial reconnaissance in economic geology, mention may be made of the Orinoco basin of eastern Venezuela, the Lake Maracaibo borderland (the scene of some of the most important oilfields in Venezuela), the Venezuelan-Colombian borderland, much of which is potential oil-bearing territory and where, moreover, aerial methods were successfully employed to settle a long-standing boundary dispute between the two republics, the Magdalena and Atrato River basins of Colombia, and much of the Tampico-Tuxpam oil-belt of eastern Mexico. Parts of Brazil have, for other geological purposes, been explored in the same way, while other instances might be cited from North America, Canada, Australia, New Guinea, Borneo, and the Dutch East Indies.

SILVER ASSAY AT BROKEN HILL.

In *Chemical Engineering and Mining Review* for January, F. C. Johns discusses the relative accuracy of the different methods of assay for silver as exemplified by practice at Broken Hill. Of the three metals assayed on the Broken Hill field, namely, lead, zinc, and silver, the latter stands out as being the most difficult to assay. To become skilful in the fire assaying of silver much practice together with great judgment of temperature is required to obtain concurrent results. This paper was written to show the variations which are obtainable by various methods, and for this purpose the following methods will be compared : (1) Scorification. (2) Pot assay (nitre method). (3) Pot assay (nail for desulphurizing).

Scorification Method.—100 grains of ore is sufficient : 0·3 gr. assay ton (326·66 gr.) may be used. The granulated lead varies ; for a lead concentrate it may be from 6 to 10 times the weight of ore ; for a zinc concentrate, from 10 to 15 times the weight of ore ; and for crude ore, from 10 to 15 times the weight of ore.

Half the charge of lead is weighed and placed in the scorifier (a 3 in. shallow Battersea for preference) ; then the ore is placed on top of the lead and the whole thoroughly mixed. The balance of the lead is then placed on top as a cover and 50 grains of fused borax added. The assay is then scorified in a muffle furnace at a bright red heat until the " eye " nearly closes, then most of the slag can be poured off into an iron mould and discarded. The assay is again returned to the furnace to further reduce the lead button to the size required. The charge is then poured and the lead button containing the silver detached from the scoria, hammered into a cube—the ideal lead button should weigh from 100 to 150 grains—and cupelled.

For scorifying zinc concentrate more heat is necessary than for lead concentrate, otherwise the slag is more viscous with a greater risk of small quantities of silver being slagged off.

Pot Assay (Nitre Method).—Take half an assay ton (grain) of ore and mix with following fluxes :—

	Lead concentrate and crude sulphide Grains.	*Zinc concentrate* Grains.
Litharge	500	700
Sodium bicarbonate	200	200
Borax glass	100	100

Calculate the amount of nitre to give a button weighing about 150 grains.

The charge is thoroughly mixed in an F crucible and covered with a thin layer of salt, fused at a bright red heat, poured, and, when cold, the lead button is detached from the slag, hammered into a cube and cupelled.

Pot Assay (Nail for Desulphurizing).—Take half an assay ton (grain) of ore and one assay ton of residues, and mix with the following :—

	grains.
Soda bicarbonate	300
Litharge	200
Borax, as cover	150
Argol	30

An iron rod or nail is placed in charge except in case of carbonate ore. Fuse quickly and pour.

TABLE I.

No.	Product.	Approx. assay. Lead %	Zinc %	Assays. Scorification, Oz. per ton.	Pot (Nitre) Oz. per ton.	Pot (Nail) Oz. per ton.
1.	Lead concentrate	66	7	35·1	35·1	34·3
2.	,, ,,	—	—	34·3	34·3	33·3
3.	,, ,,	—	—	35·9	35·8	34·8
4.	,, ,,	—	—	33·9	33·9	33·1
5.	,, ,,	—	—	33·9	33·6	33·0
6.	,, ,,	—	—	33·4	33·2	32·7
1.	Lead zinc middling	29	29	33·9	33·6	31·8
2.	,, ,,	—	—	34·0	33·8	31·9
3.	,, ,,	—	—	33·9	34·0	32·0
4.	,, ,,	—	—	33·9	34·0	32·0
5.	,, ,,	—	—	34·0	33·7	32·0
6.	,, ,,	—	—	33·6	33·7	32·1
1.	Crude ore	15	13	13·7	13·7	13·4
2.	,,	—	—	12·0	11·9	11·8
3.	,,	—	—	12·6	12·6	12·4
4.	,,	—	—	12·7	12·7	12·4
5.	,,	—	—	12·6	12·6	12·5
6.	,,	—	—	12·0	12·0	12·0
1.	Zinc concentrate	9	44	9·6	9·5	9·3
2.	,, ,,	—	—	9·0	9·1	8·8
3.	,, ,,	—	—	10·2	10·4	10·0
4.	,, ,,	—	—	9·8	10·0	9·5
5.	,, ,,	—	—	10·4	10·7	10·2
6.	,, ,,	—	—	9·4	9·5	9·2

Table I gives comparisons showing variations of the three methods. A summary of experiments on the above products gave the results on Table 2. From these figures it will be seen that the scorification and nitre pot assays give identical results, whereas the pot assaying using an iron rod shows greater loss of silver.

Cupellation.—The process of cupellation must be conducted with great care and skill. The loss of silver varies under favourable conditions, but if a high temperature is used, the silver loss becomes

much greater. Cupellation should be started at a bright red heat. When the cupels "uncover" the temperature should be lowered rapidly to the lowest point at which the operation can proceed. Towards the finish of the process the temperature should be increased slightly by closing the muffle door. No feathers of litharge should be left on the cupels when finished, otherwise minute quantities of lead may remain and thus give high results.

Assay Disagreements on 0·5 oz. Margin.—All the contracts on Broken Hill products stipulate for a 0·5 oz. limit for agreement of assays. Should the difference be greater the sample is sent to an umpire assayer. It is, therefore, interesting to show how the different variations in grade are affected (see Table V). From this it will be seen that for ores assaying 3–13 oz. of silver, few assays are umpired; but as the silver value rises, so does the difficulty to agree with the buyer or seller's assayer become greater. It will be seen that for products assaying 65–75 oz. practically every three out of four assays are submitted to the umpire assayer. It is, therefore, quite evident that for ore assaying over 70 oz. per ton 0·5 oz. allowance is not practical.

Table II.

Product.	No. of tests.	Scorification.	Assays Pot (Nitre)	Pot (Nail)	Compared against scorification Pot (Nitre)	Pot (Nail)
Lead concentrate	32	33·66	33·68	32·9	·02 higher	·76 lower
Lead-zinc middling	20	33·76	33·68	31·84	·08 lower	1·92 ,,
Crude ore	28	11·51	11·46	11·32	·05 lower	·19 ,,
Zinc concentrate	15	9·81	9·95	9·58	·14 higher	·23 ,,

Table III. Cupellation Variations Using Mabor and Bone-ash Cupels.

	Product.	Assay Mabor	Bone ash.	Remarks.
1.	Lead concentrate	30·7	30·0	
2	,, ,,	30·7	29·9	Bone ash cupels = 0·61 oz. lower than Mabor.
3.	,, ,,	31·0	30·0	
4.	,, ,,	31·1	30·4	
5.	,, ,,	27·8	27·4	French bone ash gave an average of 0·13 oz. higher results than English.
6.	,, ,,	28·8	28·2	
	Average of 72 experiments	31·1	30·49	

It will be seen from Table III that bone ash cupels absorb much more silver than Mabor, thus proving bone ash to be an inferior material for making cupels. Morganite cupels were also tested, and, practically, the results were the same as those obtained with Mabor. Morganite cupels require a little more heat for cupelling than Mabor.

Table IV. Cupellation Variations.

Example.	Wt. of prill (grains).	Oz. per ton
	0·238	77·74
	0·23	75·13
1.	0·228	74·47
	0·24	78·39
	0·238	77·74
	0·238	77·74
	0·057	18·62
2.	0·055	17·96
	0·053	17·31
	0·053	17·31

The examples in Table IV are given to show the variations which an assayer experiences at times in the process of cupellation. All the cupellations were made independently, that is, they were not cupelled side by side at the same time. The figures are quoted to show how difficult is the task of judging temperature for cupelling. One might cupel duplicates alongside each other and get a perfect agreement and yet disagree with the buyer or seller's assay when compared, and be forced to umpire and lose for being either too high or too low.

Table V.

Approx. assay.	Percentage umpired.
3–13 oz. ag.	5·0
15–19 ,,	14·0
30–35 ,,	24·0
65–75 ,,	71·0

A Muffle Furnace.—As the scorification assay is adopted for all contracts for the sale of Broken Hill products, a description of a most up-to-date gas-fired muffle furnace used in F. G. White's assay office at Broken Hill may be interesting. It is a No. 10 blast furnace supplied by Fletcher Russell and Co., England. It will take twelve 3 in. shallow Battersea scorifiers. Any temperature sufficient for scorification and cupellation can be maintained with perfect oxidation when properly regulated. The gas and sufficient air supplied from a small blower, giving a pressure of at least 3 lb. of air per sq. in. and driven by a 1½ h.p. motor, is passed along, under the muffle, then circulates past the back and over the top to front of furnace, and, finally, the waste gases are led into a flue which is connected to the chimney stack. By arranging the circulation of gas in this manner greater economy is obtained. Another feature is that air can be circulated through the muffle by means of a hole 1 in. diameter in the centre of the muffle door, and also by opening the door a little when necessary to allow more air to pass through the muffle. All the air and fumes pass through the holes of the muffle and up the chimney with the waste gases. The only time the fumes come out of the front is when the door is opened for pouring etc. The muffles are made with five holes ¾ in. diameter on the sides and three holes at the back equally spaced. The holes are placed so that the bottom is about level with the top of the scorifiers. The side holes are arranged with the three bottom holes starting about 1 in. from the inside of the end of the muffle and 2 in. apart and the two top holes placed midway between the centre, and the ends holes about ¾ in. above the bottom row. This type of furnace when properly controlled is very satisfactory.

Bentonite.—Technical Paper 438 of the United States Bureau of Mines contains an account by C. W. Davis and H. C. Vacher of bentonite, a mineral substance about which little has been written, the pamphlet by H. S. Spence published by the Department of Mines, Ottawa, in 1924, being the only other publication dealing expressly with it. According to Messrs. Davis and Vacher, certain bentonites have such strong affinity for water that they are capable of absorbing more than ten times their volumes of water. Owing to its peculiar physical properties, bentonite has been suggested as a component material in the manufacture of a great variety of commodities, such as paper, rubber, putty, phonograph records, pencil leads, and soaps. On the other hand, underground deposits of bentonite have caused great difficulties in the drilling of oil-wells, it frequently becoming necessary to take special steps to combat the nuisance. Bentonite is a rock that contains 75% or more of the crystalline clay-like mineral, montmorillonite, a member of the Kaolin group.

For a long time investigators have recognized the occurrence of a peculiar clay-like substance, which, when wet with water, resembles soft soap and has been called "mineral soap" or "soap clay." Early reports show that such material had long ago been used at the Hudson Bay posts in Canada or washing blankets. The first shipments for commercial purposes were made in 1888 by William Taylor, of Rock Creek, Wyoming, after whom the material was called "taylorite." In 1898, however, it was learned that the name taylorite had already been used as a mineral name for potassium ammonium sulphate, so that this substance was then designated as bentonite, from its occurrence in the Fort Benton formation of the Rock Creek district. At the time considerable interest in bentonite was aroused, but it quickly subsided and the price of $25 per ton was soon reduced to $5 per ton. Within the last few years the interest in bentonite has revived, resulting in investigations that have developed industrial processes and products in which bentonite apparently has an important part. The prices to-day for the finely pulverized material approach the first quoted price.

Of the many uses suggested only a few have been tested, and investigators have not worked out the properties of bentonite that determine its usefulness or made tests to determine what type of material is best suited to the different uses.

Bentonite deposits occur in beds from a few inches to many feet thick, mainly in the Tertiary, but to some extent in the Palaeozoic and Mesozoic rocks in many parts of the United States and Canada, and deposits have been reported from Mexico, China, and France. Most bentonite deposits are the result of devitrification and partial decomposition of glassy volcanic ash.

Bentonite outcrops are unique and striking. As little vegetation will grow on them, they are barren, and because of the peculiar physical properties of bentonite these weathered outcrops often present a crinkled coral-like appearance. If the internal portion of bentonite at an outcrop is dry, it finally absorbs water and swells greatly, producing cracks in the surface layer, which has meanwhile become more or less dry. After a rain many bentonite outcrops are covered with a thick mass of slippery jelly, but in dry weather the surface may be dry and fluffy or may have a peculiar granular appearance.

The bentonite of Wyoming is usually considered a standard type in studying other so-called bentonites. One of the important producers of the material has deposits at Medicine Bow and a grinding plant at Cheyenne. Another important producer in Wyoming has a mine at Clay Spur, near Newcastle. A large new deposit of bentonite has recently been reported in Johnson County.

The largest known California bentonite deposits occur in the arid desert region along the Amargosa River in Inyo County. What is possibly an extension of the Wyoming bentonite occurs near Belle Fourche, South Dakota. On claims owned by one company at this place, there is estimated to be millions of tons of high-grade bentonite. Many other deposits have been found in Nevada, New Mexico, Idaho, Tennessee, Kentucky, Alabama, and other states.

Nearly all deposits of bentonite contain gritty or sandy inclusions, which are considered impurities and must be removed before marketing. Pulverized bentonite is fine-grained and commonly light-coloured, ranging from cream to olive green; but it may be pink, dark brown, or even black, the colour usually, but not always, becoming darker on wetting. When fired the colour is white, buff, or brown. When cut the fresh material usually has a waxy lustre, which may become dull or powdery on drying. Some varieties may be cut into thin shavings.

Prospectors or others who become interested in the production of bentonite should make a careful investigation of the commercial possibilities of the deposit in question before investing heavily. Such a study should include the possibility of marketing the product, the specifications demanded, the price obtainable, the cost of mining, treating, and shipping to market, the size of the deposit, and the nature of the crude bentonite. It should also be realized that most consumers desire a homogeneous product which will remain uniform over a period of years and that deposits containing bentonite which will do this are not common. Most crude bentonites contain appreciable quantities of objectional impurities such as sand, gypsum, carbonaceous matter, or soluble salts that must be removed at considerable expense by washing. The purified bentonites from different deposits and even from different levels or parts of the same deposit may have very different properties, such as variation in colour, colloid content, and ease of hydration. In general, consumers want a clean, homogeneous, finely divided substance.

Purified, ground bentonite should make admirable fillers, binders, or plastics in the manufacture of numerous industrial materials, due to its general characteristics, such as extreme state of fine division, property of remaining in suspension, plasticity, and high absorbent power. Thus bentonite should be useful in the manufacture of paper, linoleum curtain cloth, cordage, rubber, ceramics, Portland cement, lubricating greases, putty, phonograph records, crayons, plasters, paste, glue, shoe and stove polishes, and numerous other materials.

The characteristics of bentonite as an adsorbent, emulsifier, or peptizer, should make it available in the manufacture of soaps and detergents, horticultural sprays, animal dips, insecticides, fungicides, paints, inks, water-proofing plasters, and dynamite; in the de-inking of printed papers, the refining of oils and fats, and in the removal of water from petroleum. As a chemical reagent

bentonite should be of value as a water softener, as an aid to soil fertility, and in the treatment of molasses. It is also suggested for use as a medical dressing, in certain drugs, and in beauty clays.

Californian Borax.—In the *Engineering and Mining Journal* for January 19, P. D. V. Manning, of San Francisco, discusses the production of borax in California during the year 1928.

During the past several years, the price of borax has been steadily declining. In 1927 it reached a new low figure of $40 to $50 per ton on contract sales and this price included delivery. This is just half the old delivered price and some sales were undoubtedly made at figures lower than these. When considered over the period of years within which this price trend obtains, it is perhaps remarkable that new uses for this substance have not been developed. This is explained, however, by the fear on the part of those interested that these low prices might be the result of a price war which would be short-lived. With the American Potash and Chemical Co. producing at plant capacity and the Pacific Coast Borax Co. working their deposits at Kramer, this fear on the part of the consumer is apparently groundless and borax can now advantageously enter into competition with soda ash in certain fields.

Further strengthening of the situation from the user's standpoint is drawn from the fact that the number of producers increased during the past year. The principal producers with estimated production during 1928 were :—

Producer.	*Approximate Production in Tons per Month.*
In the Kramer district :	
Pacific Coast Borax Company .	6,000
Western Borax Company (began production in November) . .	2,000
At Searles Lake :	
American Potash and Chemical Co.	4,000
Westend Chemical Company . .	400

In addition, there are several small producers in the Kramer and Searles Lake districts.

Production of borate ores showed a further decline during the year with indications that this will continue unless new uses are found for ulexite and colemanite. A possibility here is the ceramic industry, but the problems presented by non-uniformity of raw material have yet to be overcome. It is in the glass and textile industries that there is eminent opportunity for borax to replace other alkalies. In spite of the low prices, the producing end of the industry is evidently in a healthy state and there is little doubt that production will increase in 1929. The refining centre is moving west, it being reported that the Pacific Coast Borax Company is to cease its operations at Bayonne and carry on all of this work in California.

Two features stood out in the American borax market last year. First came the record-breaking shipment to outside countries. Exports of borax amounting to $3,220,000 for the first 10 months of 1928 are 33% greater than for the entire year 1927. Estimates on the full year 1928 indicate nearly a 60% increase over 1927. Europe and the Far East are the largest consumers of American borax, the North, Central American and West Indies section ranks third, with South American fourth. The largest increases in the purchases of American borax by individual countries estimated for the entire year 1928, are in France 220%, Germany 120%, Italy 142%, Netherlands 30%, United Kingdom 33%, China 1,500%, Hongkong 500%, the Philippines 54%, and Japan 4%. Those of the principal consumers whose purchases are less for the 10 months of 1928 than for the entire year 1927 are Canada, Brazil, and Colombia. However, the estimated total for this group for the entire year 1928 is about equal to 1927 sales.

The second feature was found in the low prices at which borax was offered. This was occasioned partly by competition among sellers but mainy because production was proceeding along lines where costs were much lower than had been the case in preceding years. Production of borax also has been gaining in volume. In 1927 the domestic output was reported at 64,864 tons valued at $5,072,278, which compares with 49,967 tons valued at $4,083,209 in 1925 and 53,092 tons valued at $5,102,148 in 1923.

Notes on a Tunnel at Rio Tinto.—At the February meeting of the Institution of Mining and Metallurgy a paper on this subject was presented by C. R. Julian, and dealt with excavation methods, drills, and drill steels, blasting (including the experimental use of the Cordeau Bickford fuse), mucking, labour, ventilation, and costs.

SHORT NOTICES

Aluminium Patents.—In *Industrial and Engineering Chemistry* for February, L. Van Doren gives the history of the granting of the Hall and Heroult patents of 1886, with the object of exemplifying the many pitfalls in patent law that beset the inventor.

Geology of Coal.—In *Economic Geology* for January, G. C. McFarlane writes on the igneous metamorphism of coal beds and its effects.

Ore Deposition.—In *Economic Geology* for January, C. D. Hulin writes on structural control of ore deposition, more particularly in connection with conditions controlling the formation of ore-shoots.

Migration of Iron.—In *Economic Geology* for January, N. J. Harrar discusses the solvent action of organic acids on oxides of iron.

Mercury Production in Nevada.—In the *Engineering and Mining Journal* for January 5, H. W. Gould describes the mercury deposits in Pershing County, Nevada, the method of mining, and the metallurgy.

Patino Mines, Bolivia.—*Mining and Metallurgy* for February reprints a paper by R. S. Handy which gives an outline of the industries associated with the Patino mines, Bolivia, and of the conditions of work in the Andes.

Corrosion of Tin.—At the February meeting of the American Institute of Mining and Metallurgical Engineers, Dr. C. L. Mantell presented a lengthy paper on the corrosion of tin and its ores.

F. W. Bradley's Reminiscences.—*Mining and Metallurgy* for February reprints an address by the president elect, F. W. Bradley, in which he recounted his early experiences in western America, in association with Thomas Mein, H. C. Perkins, Hamilton Smith, and others.

Lead-Fume Recovery.—In the *Engineering and Mining Journal* for February 9, W. H. Rowley describes the Evans-Wallower method for recovering dust at a lead oxide plant.

Mining of Magnetite.—In the *Engineering and Mining Journal* of February 2 and 9, A. M. Cummings describes the mining of magnetite at the Mineville district, New York.

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.*

19,145 of 1927 (303,574). D. F. Campbell and Electric Furnace Co., Ltd., London. Improved method of making refractory linings for furnaces.

20,987 of 1927 (275,672). J. Blumenfeld, London. Manufacture of compounds of titanium or other rare earth metals involving hydrolysis of an appropriate salt solution by heating, in which the hydrolysis is initiated in an aqueous liquor of low concentration and the concentration is gradually increased by adding a substantially concentrated solution of the appropriate salt the addition being effected with agitation over a prolonged period of time and preferably at a substantially uniform rate.

25,252 of 1927 (303,393). J. F. Newsom, Palo Alto, California. A hydraulic classifier having multiple transverse rows of cells or troughs with means for supplying fresh water to the bottoms of the cells to create an ascending current therein, in which transverse streams of water are supplied in the cells to prevent packing of material.

26,056 of 1927 (303,459). Stanley Robson, Avonmouth, B. Lambert, Oxford, and National Processes, Ltd., London. Methods of simplifying the treatment of roaster gases required in making them suitable for the contact method of sulphuric acid manufacture.

26,812 of 1927 (304,174). F. L. Duffield, London. Improved method of reducing iron ores.

27,954 of 1927 (304,371). Bell Telephone Laboratories, New York. Process of refining nickel or alloys consisting principally of nickel, which consists of bringing the nickel to a molten state and adding thereto a substance comprising one or more of the metallic members of the vanadium group of elements.

28,677 of 1927 (304,829). W. Witter, Halle, Germany, and M. Lissauer, H. Lissauer, and B. Goiesman. Process for purifying tin ores by roasting with powdered coal.

34,857 of 1927 (304,893). T. D. Kelly, London. An alloy of iron, chromium, nickel, and copper and means for making same.

34,896 of 1927 (282,772). M. Buchner, Hanover. Process of producing pure alumina compounds from materials containing alumina by dissolving such materials with nitric acid, with application of heat and pressure, in a vessel consisting of an alloy of iron, nickel, and chromium, with or without tungsten or similar additional metal.

4,225 of 1928 (304,052). L. Deutsch, Budapast. Method of producing copper sulphate in briquette of small regular size, as a more convenient commercial form than the present mixture of large and small crystals.

4,226 of 1928 (304,053). S. I. Levy and G. W. Gray, London. Method of producing pure iron and pure chlorine by the electrolysis of ferrous chloride.

4,278 of 1928 (304,492). J. I. Bronn, Charlottenburg, Berlin. In the manufacture of refractory bricks of chromite, the use of a fused cement as binder.

4,301 of 1928 (304,054). S. I. Levy and G. W. Gray, London. In the treatment of pyrites residues with hydrochloric acid a concentrated solution of ferrous chloride is obtained containing all the lead present in the original mineral; this patent deals with the separation of the lead from the solution.

4,908 of 1928 (291,391). R. Godet, Ploesti, Roumania. A new rotary drill for boreholes.

5,613 of 1928 (304,937). C. P. Debuch, Bochum, Germany. Means for discharge of gases in rotary tubular furnaces such as are used in certain ore treatment processes.

7,564 of 1928 (304,508). A. R. Brown and J. I. Yeats, London. A concentrator for use in alluvial mining consisting in a rotatable hollow cylinder provided internally with a series of shaped annular baffles or diaphragms disposed perpendicularly with respect to its axis and in contact with its wall and having openings provided with removable covers in its wall on the feed entry side of each baffle for the discharge of concentrate.

6,393 of 1928 (303,684). Metallbank und Metallurgische Gesellschaft, Frankfort on Main. Copper-silicon alloys which are suitable for casting purposes.

9,661 of 1928 (294,197). Compagnie des Metaux Overpelt-Lommel, Overpelt-lez-Neerpelt, Belgium. Improvement in apparatus for roasting and sintering fine ores.

14,699 of 1928 (304,548). E. Abel, Vienna. Bearing metals consisting chiefly of lead in which the necessary characteristic is obtained by microscopic amounts of rubidium or caesium, the amount being between 0·001 and 0·005%.

15,687 of 1928 (303,328). H. Harris, London. Process for the purification of antimonial lead alloys or other antimonial metals, in which the molten alloy is brought into intimate contact with a mixture of caustic alkali and alkali chloride at temperatures between the melting point of the alloy and 550° C.

19,404 of 1928 (293,359). I. G. Farbenindustrie A.G., Frankfurt am Main. Re patent No. 275,985, various manganese silicon alloys are proposed for pistons of internal combustion engines.

32,430 of 1928 (304,580). N. V. Philips Gloeilampenfabricken, Eindhoven, Holland. Process for coating metallic or non-metallic bodies with osmium.

35,878 of 1928 (303,096). C. P. Debuch, Bochum, Germany. A process for working rotary tubular furnaces with gas feed openings distributed either over a part of over the whole of the furnace wall, in particular for roasting ores poor in sulphur and difficult to roast, such for example as zinc blende, characterized by the fact that fuel is fed to the furnace at several points simultaneously.

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.

Evolution of the Igneous Rocks. By N. L. Bowen. Cloth, octavo, 340 pages. Price $5.00. Princeton, New Jersey: The Princeston University Press.

Matthew Murray, Pioneer Engineer. Records from 1765 to 1826, edited by E. Kilburn Scott. Pamphlet, 132 pages, illustrated. Price 2s. 6d. Leeds: Edwin Jowett, Ltd.

Geology of Country around Lonely Mine. By A. M. Macgregor. Bulletin No. 11 of the Geological Survey of Southern Rhodesia.

Deterioration of Colliery Winding Ropes in Service, with description of some typical failures. By S. M. Dixon, M. A. Hogan, and J. M. Robertson. Paper covers, octavo, 42 pages, illustrated.

Paper No. 50 of the Safety in Mines Research Board. London: The Mines Department.

La Region Située à l'Est de la Haute Wickera et des Sources de la Petchora. By L. DUPARC and M. GYSIN. Quarto, paper covers, 140 pages, illustrated. Geneva: Imprimerie Albert Kundig.

Les Gisements Platinifères du Birbir (Abyssinie). By L. DUPARC and E. MALLEY. Pamphlet, 20 pages, illustrated. Reprint from the Swiss Bulletin of Mineralogy and Petrography.

Physikalische Probleme im Aufbereitungswesen des Bergbaus. By Dr. SIEGFRIED VALENTINER. Octavo, paper covers, 110 pages, illustrated. Price 7 marks. Braunschweig: Fried Vieweg und Sohn A.G.

COMPANY REPORTS

Modderfontein B.—This company belongs to the Central Mining-Rand Mines group and was formed in 1908 to work ground east of the New Modderfontein in the Far East Rand. The report for the year 1928 shows that 830,000 tons was milled for 312,653 oz., an average of 7·534 dwt., the revenue being 32s. 3d. and the working costs 18s. 3d. per ton milled. The total working profit was £580,280, as compared with £588,803 for 1927. The ore resources at the end of 1928 were 1,814,800, value 7·5 dwt., as compared with 2,273,320 tons, value 7·4 dwt., at the end of 1927. Dividends totalling 80 per cent. absorbed £560,000, the balance unappropriated at the end of the year being £356,050.

Petaling Tin.—This company belongs to the Osborne and Chappel group and was formed in 1920 to work areas in Selangor, F.M.S. The report for the year to October 31, 1928, shows that 3,860,350 cubic yards were treated for 22,889 piculs, value $1,456,175. After providing for normal depreciation and transferring $18,500 to property redemption, the profit amounted to $598,558. With the final dividend of 7½% and the bonus distribution of 5% recommended the total distribution for the year totals 35%.

Anglo-Burma Tin.—This company belongs to the Anglo-French group and was formed in May, 1926, to work alluvial tin properties in the Tavoy and Mergui districts of Lower Burma. The report for the year to June 30, 1928, shows that to the end of December 231,900 cubic yards was treated for 121 tons of tin concentrates. So far neither of the plants has been working to full capacity, so that the returns have been less than anticipated, but the general manager expects to increase the output materially during the ensuing rainy season.

New Consort Gold Mines.—This company belongs to the Bailey group and was formed under Union of South Africa laws in 1925 by the South African Townships Mining and Finance Corporation to acquire the Consort gold mine at Noord Kaap in the Barberton district of the Transvaal. The adjoining Maid of De Kaap was acquired later. The report for the year ended June 30 last shows that 10,190 tons of ore was raised from the Consort and 8,965 tons from the Maid. The total ore treated was 18,900 tons averaging 86s. gold per ton. The yield of gold was £66,286, in addition to which £10,695 was extracted from 12,852 tons of accumulated sand. The working cost of the ore treatment was £41,340, leaving a working profit of £24,946, while a profit of £3,467 was made by the treatment of accumulated sand, making, with other small items, the total profit £28,928. Development gave good results during the year and the reserve at the two properties was estimated on June 30 at 71,185 tons averaging 96s. 5d. per ton.

NEW COMPANIES REGISTERED

Arran Barytes.—Registered February 15. Capital: £50,000 in 35,000 "A" and 15,000 "B" shares of £1. Directors: G. A. Dougall, J. A. Gordon, G. E. Thomson, R. Robertson. Office: 79, West Nile Street, Glasgow, C. 1.

Conception Ecuadorian Oilfields.—Registered January 16. Capital: £50,000 in 40,000 Ordinary shares of £1 and 40,000 Deferred shares of 5s. Objects: To adopt agreement with French, British, and Foreign Trust and to acquire any petroleum or oil-bearing lands in Ecuador or elsewhere.

Gold Coast Consolidated Lands.—Registered February 9. Capital: £35,000 in 2s. shares. Objects: To adopt agreement with Gold Coast Consolidated Lands and L. N. Billson, liquidator thereof. Directors: J. A. Cooper, S. Bratchell. Office: Broad Street House, Old Broad Street, E.C. 2.

Malaysiam Tin.—Registered February 22. Capital: £250,000 in 5s. shares. Objects: To adopt two agreements with the Universal Engineering and Development Company and Selangor Tin, etc.

Nigerian Electricity Supply Corporation.—Registered February 11. Capital: £200,000, in £1 shares. Objects: To produce, generate, and distribute electrical energy or power, etc. Directors: Hon. L. Holland (chairman Associated Tin Mines of Nigeria), H. G. Latilla (chairman Nigerian Base Metals Corporation), Major E. S. Marks (managing director Associated Tin Mines of Nigeria). Office: Finsbury Pavement House, E.C. 2.

Oliver United Filters.—Registered February 8. Capital: £1,000 in £1 shares. Office: 150, Southampton Row, London, W.C.

Parent Coal Carbonisation Trust.—Registered February 20. Capital: £750,000 in 1,200,000 Eight per Cent. Cumulative Participating Preference shares of 10s. and 3,000,000 Deferred Ordinary shares of 1s. Object: To adopt agreements (*a*) with Maisel's Petroleum Trust, (*b*) with the said Trust and Fordhams' Trust, and (*c*) with the said Fordhams' Trust; to acquire rights for Great Britain of a secret process for low temperature carbonization of coal known as the Aicher Process, etc. Directors: Lord Askwith, E. Cohen, R. F. M. Scott.

Petroleum Refineries.—Registered February 20. Capital: £470,000 in 700,000 Participating Preferred Ordinary shares of 10s., and 2,400,000 Ordinary shares of 1s. Objects: To adopt agreement with Furmanite Engineering Company, etc. Office: 28, Grosvenor Place, S.W. 1.

Rosey Cross Asbestos Mines of Rhodesia.—Registered February 21. Capital: £70,000 in 1s. shares. Objects: To acquire certain mines and mining claims in Southern Rhodesia known as Rosey Cross, Rex, St. Anthony, Price and Priceless Blocks.

Sungei Pari Hydraulic Tin.—Registered January 24. Capital: £230,000 in 5s. shares. Objects: To adopt agreement with Anglo-Scottish Tin Corporation and British Malayan Tin Syndicate.